Vol. 10, No. 6
March 31, 1985

Energy Research Abstracts

Abstracts 9430-10828

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Office of Scientific and Technical Information; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $72.00 for domestic (North America) or $90.00 for foreign (outside North America) subscribers; a single issue is $5.00 or $6.25, respectively.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

DOE Patents Available for Licensing (PAL)

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available on subscription (use PB85-946800) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $14.00 for domestic (North America) or $28.00 for foreign (outside North America); a single issue is $7.00 or $14.00, respectively.

Energy Meetings (EM)

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB85-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $40.00 for domestic subscribers and $80.00 for subscribers outside the North American continent; a single issue is $5.00 and $10.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription price (12 issues plus cumulative index) is $75.00 for domestic (North America) and $150.00 for foreign (outside North America) subscribers; a single issue is $7.00 and $14.00, respectively.

***Current Energy Patents (CEP)*–PB85-902800**

Devoted to international patent literature, including patent applications, on any aspect of energy production, conservation, and utilization.

***Energy and the Environment (EAE)*–PB85-914900**

Devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

***Fossil Energy Update (FEU)*–PB85-914600**

Devoted to information on the exploration, development, processing, and use of fossil fuels.

***Fusion Energy Update (CFU)*–PB85-915300**

Devoted to information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

***Solar Energy Update (SEU)*–PB85-914500**

Devoted to information on the utilization of solar energy, including biomass and tidal and wind power.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $40.00 for domestic (North America) and $80.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB85-901000**

Covers all aspects of acid precipitation, including effects and possible control measures.

***Buildings Energy Conservation (BEC)*–PB85-900700**

Covers worldwide information on the technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)*–PB85-901400**

Covers all aspects of conversion of coal into gaseous or liquid fuels.

***Coal Preparation and Pollution Control (CPC)*–PB85-900800**

Covers all aspects of coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB85-946600**

Covers the following areas: photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB85-900600**

Covers worldwide information on all aspects of biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB85-914700**

Covers information on the exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*–(PB85-900500)**

Covers all aspects of heavy-ion (A > 4) reactions.

***Laser Research (LAR)*–PB85-901100**

Covers all aspects of laser research and development, but excludes applications.

***Nuclear Fuel Cycle (NFC)*–PB85-913400**

Covers all aspects of the nuclear fuel cycle, both front end and back end.

***Nuclear Reactor Safety (NRS)*–PB85-913500**

Covers the safety aspects of accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB85-902900**

Covers the management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB85-901200**

Covers research in materials, concentrators/receivers, salinity gradients, etc., for development of efficient and reliable solar thermal conversion systems.

***Unconventional Petroleum (UCP)*–PB85-901300**

Covers all aspects of secondary and tertiary recovery of petroleum and of oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information in any step involved in the eventual conversion of biomass to energy. *Biomass Abstracts* is available free to Department of Energy components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to Department of Energy components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, OSTI builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to OSTI's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of OSTI's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Office of Scientific and Technical Information has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications; OSTI also serves as adviser for special publication needs of the Department. To effectively manage DOE's technical information resources, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

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United States Department of Energy, P. O. Box 62, Oak Ridge, TN 37831

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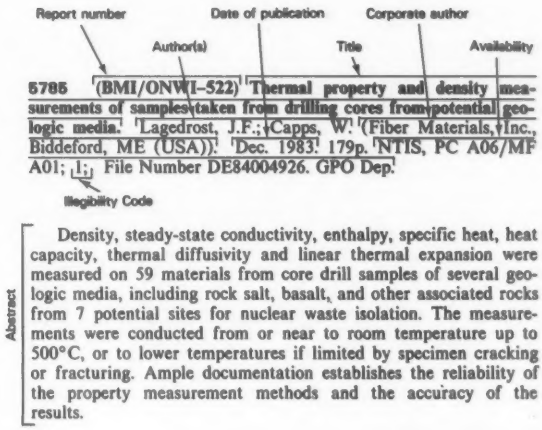
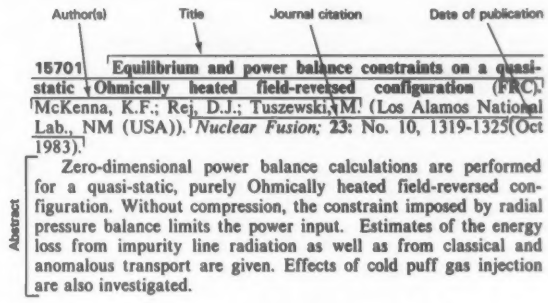
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.
Illegibility Code
Abstract
Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325(Oct 1983).
Abstract
Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
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Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830 **Fiber Materials, Inc., Biddeford, ME (USA)** 9:5785 BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522 9:5785 NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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Much of the information is provided by (1) bilateral exchange agreements with foreign organizations and (2) exchange agreements or contracts with other U. S. government agencies, private firms, or institutions.

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CEA Centre d'Etudes de Saclay
GIF-sur Yvette Cedex, France

Fachinformationszentrum
Energie, Physik, Mathematik GmbH
Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
Dublin, Ireland

IEA Coal Research
Technical Information Service
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Springfield, VA

National Institutes of Health
National Library of Medicine
Bethesda, MD

Plenum Publishing Corporation
New York, NY

University of Tennessee
Graduate School of Library and Information Sciences
Knoxville, TN

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R5 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

9430 (ORNL—6108) Fossil Energy Program quarterly progress report for the period ending September 30, 1984. McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 134p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85004939.

This quarterly report covers the progress made during the period July 1 through September 30 for the Oak Ridge National Laboratory research and development projects that are carried out in support of the increased utilization of coal and other fossil fuels as sources of clean energy. These projects are supported by various parts of DOE including Fossil Energy, Basic Energy Sciences, the Electric Power Research Institute, and by the Tennessee Valley Authority through inter-agency agreement with DOE.

0104 Processing

REFER ALSO TO CITATION(S) 0104009486, 9495, 9531, 9531, 9536, 10078

9431 (ANL/FE—83-31) Corrosion of ceramic refractories exposed to synthetic coal slags by means of the rotating-cyclinder technique: an interim report. Greenberg, S.; Poeppel, R.B.; Fousek, R.J.; Grajek, W.J.; Galvin, T.M.; James, J.; Stair, K.E.; Sanecki, J.E. (Argonne National Lab., IL (USA)). Sep 1984. Contract W-31-109-ENG-38. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004824.

A rotating cylinder refractory/slag corrosion facility was designed and built to expose cylindrical samples of refractory to molten slag under controlled conditions of slag composition, oxygen partial pressure, temperature, and speed of rotation. The effects of slag composition, temperature, and rotational speed on the corrosion of chromia-containing refractories were studied. 25-mm (1-in.)-dia x 25-mm (1-in.)-high refractory cylinders are rotated at a controlled rate (50 to 200 rpm) in slags of known composition, under controlled temperature (1480 to 1600°C) and oxygen partial pressure ($\sim 10^{-8}$ to $\sim 10^{-10}$ atm) conditions. Refractories containing 60 to 80% Cr_2O_3 showed negligible corrosion at 1500°C. At 1600°C, significant differences between refractories of similar composition were apparent, particularly at high rotational speeds. Subtle mineralogical differences among the various high-chromia refractories are the apparent cause of the differences in corosion rates. Low-chromia (10% Cr_2O_3) refractories showed greatly accelerated corrosion rates in comparison with the high-chromia refractories.

9432 (DOE/DP/00789—T99) Techno-economic assessment of the Mobil Two-Stage Slurry Fischer-Tropsch/ZSM-5 process. El Sawy, A.; Gray, D.; Neuworth, M.; Tomlinson, G. (Mitre Corp., McLean, VA (USA). METREK Div.). Nov 1984. Contract AC04-76DP00789. 173p. NTIS, PC A08/MF A01; GPO Dep. File Number DE85003890.

Report MTR-84W173.

A techno-economic assessment of the Mobil Two-Stage Slurry Fischer-Tropsch reactor system was carried out. Mobil bench-scale data were evaluated and scaled to a commercial plant design that produced specification high-octane gasoline and high-cetane diesel fuel. Comparisons were made with three reference plants - a SASOL (US) plant using dry ash Lurgi gasifiers and Synthol synthesis units, a modified SASOL plant with a British Gas Corporation slagging Lurgi gasifier (BGC/Synthol) and a BGC/slurry-phase process based on scaled data from the Koelbel Rheinpreussen-Koppers plant. A conceptual commercial version of the Mobil two-stage process shows a higher process efficiency than a SASOL (US) and a BGC/Synthol plant. The Mobil plant gave lower gasoline costs than obtained from the SASOL (US) and BGC/Synthol versions. Comparison with published data from a slurry-phase Fischer-Tropsch (Koelbel) unit indicated that product costs from the Mobil process were within 6% of the Koelbel values. A high-wax version of the Mobil process combined with wax hydrocracking could produce gasoline and diesel fuel at comparable cost to the lowest values achieved from prior published slurry-phase results. 27 references, 18 figures, 49 tables.

9433 (DOE/ET/10069—T99) EDS coal liquefaction process development, Phase V. Annual technical progress report, July 1, 1983-June 30, 1984. (Exxon Research and Engineering Co., Florham Park, NJ (USA)). Oct 1984. Contract FC05-77ET10069. 79p. (FE—2893-143). NTIS (US Sales Only), PC A05/MF A01; 1; GPO Dep. File Number DE85003901.

This report is the seventh annual technical progress report for US Department of Energy Cooperative Agreement for EDS Coal Liquefaction Process Development Phase V. The Laboratory Process Research and Development studies were conducted at various Exxon Research and Engineering Co. (ER and E) facilities: Research and Development Division at Baytown, Texas; Products Research Division at Linden, New Jersey; and the Exxon Research and Development Laboratories at Baton Rouge, Louisiana. The Engineering Research and Development studies were performed at the Synthetic Fuels Engineering and Exxon Engineering Technology Departments of ER and E at Florham Park, New Jersey. The information dealing with operation of the 250 T/D Exxon Coal Liquefaction Pilot Plant (ECLP) was generated at Exxon Company, U.S.A., Houston, Texas. Highlights for this period are summarized for the following tasks: (1) laboratory coking and gasification studies; (2) cost reduction and laboratory guidance studies; (3) engineering studies of bottoms processing/hydrogen manufacture; (4) materials and environmental engineering technology; and (5) EDS toxicology program. 17 references, 11 figures, 15 tables.

9434 (DOE/ET/10518—T6) Catalytic coal liquefaction. Quarterly report, January-March 1980. Weller, S.W. (State Univ. of New York, Buffalo (USA)). 1980. Contract AC22-76ET10518. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004179.

An extensive series of autoclave tests has been completed on the liquefaction of West Virginia coal in the presence of particulate MoO_3-CoO-Al_2O_3 catalysts ranging in average pore diameter from about 100 to 1000A. Catalysts were tested in both oxide and presulfided form. Loading of MoO_3 and CoO was always proportional to the surface area of the Al_2O_3 support; two series of catalysts varying in MoO_3 and CoO loading were tested. The amount of catalyst was varied in each autoclave run so as to keep the total weight of MoO_3 and CoO the same for each run. The principal results of this study are: (1) Conversion of coal (to liquid plus gas) increases as catalyst pore diameter increases, from 100A to 500A. The incremental effect of further increasing the pore diameter to 1000A is small and relatively variable. (2) The quality of the liquid product, as measured by the ratio of oil to oil plus asphaltenes [0/(0+A)], decreases as the pore diameter increases (in three out of four series), from 100A to 1000A. This is the result of increased production of asphaltenes as liquefaction increases, while the production of oil remains relatively constant. (3) The catalysts with Low Loading of Co and Mo produce higher liquefaction of coal, and higher yield of asphaltenes, than their counterparts with High Loading. 5 references, 4 tables.

9435 **(DOE/ET/10518—T7) Catalytic coal liquefaction. Quarterly report for October-December, 1979.** Weller, S.W. (State Univ. of New York, Buffalo (USA)). [1985]. Contract AC22-76ET10518. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005115.

MoO_3-CoO-Al_2O_3 catalysts have been prepared on particulate aluminas having average pore diameters of ca. 100, 200, 500, and 1000A, and on one pure alumina monolith. The catalysts were prepared with a constant MoO_3:CoO weight ratio of 5:1, but at two different surface loadings of MoO_3 based on the surface area of the alumina support: a High Mo series, with 9.7×10^{-4}g MoO_3/m^2 alumina, and a Low Mo series, with 4.5×10^{-4}g MoO_3/m^2 alumina. Batch autoclave testing of coal liquefaction has been carried out with these catalyst samples in both the oxide form and after prior reductive sulfiding. The results are being analyzed. The O_2 chemisorption method for determining the specific surface area of molybdena in supported catalysts has been studied at two temperatures, -195° and -78°C, and in two systems, static and dynamic. Equivalent results are obtained at -195° and -78°, but the higher temperature is to be preferred because of the much smaller correction for physical adsorption of O_2. Equivalent results are also obtained in a static or dynamic system, so either arrangement can be used successfully. 3 figures, 2 tables.

9436 **(DOE/ET/10518—T8) Catalytic coal liquefaction. Quarterly report, April-June 1981.** Weller, S.W. (State Univ. of New York, Buffalo (USA)). 1981. Contract AC22-76ET10518. 13p. (FE—2013-16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004107.

Measurements of O_2 chemisorption and BET surface area have been completed on a series of Co/Mo/Al_2O_3 catalysts. The catalysts were derived from Cyanamid 1442A and had been tested for coal liquefaction in batch autoclaves and continuous flow units. Catalyst samples were presulfided before determination of O_2 chemisorption. O_2 chemisorption values give the same rank-ordering as do the short-term liquefaction tests (batch autoclave, or initial behavior in a continuous unit). In connection with the fate of tin catalysts during coal liquefaction, calculations have been made of the relative thermodynamic stability of $SnCl_2$, Sn, SnO_2, and SnS in the presence of H_2, HCl, H_2S, and H_2O. It is concluded that, under typical liquefaction conditions, it is thermodynamically possible for $SnCl_2$ to be reduced by H_2 to metallic Sn, or to be oxidized by H_2O to SnO_2; however, SnS appears to be the ultimately stable phase. Uncertainties in the thermodynamic data for $SnCl_2$ and SnS, and possible variations in the extant partial pressures of HCl, H_2S, and H_2O, prevent unequivocal conclusions to be drawn for some of the reactions considered. Batch autoclave experiments have been completed for the comparison of SnS, SnS + NH_4Cl, and $SnCl_2$ as catalysts in the liquefaction of West Virginia coal under hydrogen pressure with a tetralin-naphthalene solvent. SnS alone behaves as poorly as no catalyst. By contrast, the combination of SnS + NH_4Cl is as effective as $SnCl_2$. These results are in agreement with old (ca 1950) experiments done in the absence of any added solvent. They leave unanswered the question of why SnS, presumably stable under autoclave conditions, should act as a hydrogenation catalyst during coal liquefaction. 5 tables.

9437 **(DOE/ET/10532—T19) Refining and upgrading of synfuels from coal and oil shales by advanced catalytic processes. Ninth interim report. Processing of Texas-lignite EDS syncrude.** Sullivan, R.F.; O'Rear, D.J.; Frumkin, H.A. (Chevron Research Co., Richmond, CA (USA)). Aug 1984. Contract AC22-76ET10532. 216p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE84015496.

EDS syncrude derived from Texas Lignite (Big Brown) was refined in an extensive program which included pilot plant and laboratory studies. Then the cost of refining was estimated from engineering studies. It was demonstrated that advanced, commercial petroleum technology can be used to refine this syncrude to gasoline, jet, diesel, and heating fuels. The EDS syncrude contains less hydrogen than petroleum crudes. It also contains large amounts of heteroatom impurities. It differs from petroleum in that it contains almost no residua and over 90% boils in the gasoline and diesel ranges. With these properties, an appropriate way to refine is by hydroprocessing. Hydroprocessing yields a volume of finished products which is 88 to 97 LV% of the original volume of syncrude. In addition, the heteroatoms are ultimately removed as sulfur and salable ammonia. The engineering studies provided estimates of the refining costs for grass roots refineries which would produce 50,000 bbl per calendar day of products. The Second Quarter 1983 refining costs range from $12 to $17/bbl of product, depending upon the desired product slate. These costs do not include the cost of the EDS syncrude itself. 36 references, 17 figures, 116 tables.

9438 **(DOE/FE/05081—1710) Engineering support services for the DOE/GRI Coal Gasification Research Program. Quarterly technical status report, September 25-December 31, 1983.** Mazzella, G. (Foster Wheeler Synfuels Corp., Livingston, NJ (USA)). 1984. Contract AC21-82FE05081. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85005413.

The scope of work under this contract consists of technical assistance in the following areas: advancing the development of coal gasification processes and related technologies to their maximum potential; gathering, compiling, and presenting essential data necessary to delineate the advantages and disadvantages of each competing process; determining and identifying the specific process and/or combination of component processing steps that offer the greatest economic potential for commercial application; performing evaluations to determine the areas of development necessary to provide all technical data, including equipment and material specifications, required for the design and construction of a commercial coal gasification facility; making recommendations and assisting in the compiling of sufficient data to complete conceptual commercial designs and prepare associated factored estimates; evaluating progress reports for consistency, compliance with contract requirements, and adequacy in providing data necessary for process evaluation; and conducting additional studies that could enhance the technical and economic assessment of coal gasification technologies. Foster Wheeler provides the required support services in accordance with task orders approved by the DOE/GRI Operating Committee. During the present quarterly period, these support efforts were primarily directed to Task No. 1, monitoring and evaluation of the following projects: Westinghouse PDU and Cold Flow Scale-Up Facility (CPSF), Mountain Fuels Resources PDU; Bell Aerospace PDU; and Metals Properties Council. In mid-December, 1983, Foster Wheeler was authorized to start work on two additional tasks; Task No. 2, Lurgi Baseline Study, and Task No. 3, Coal Fines Consolidation Study.

9439 **(DOE/MC/14600—1667) Development of coal piston feeder. Phase II report. Verification testing.** Mistry, D.K. (Ingersoll-Rand Research, Inc., Princeton, NJ (USA)). May 1984. Contract AC21-80MC14600. 140p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85001485.

This report describes the development work performed by Ingersoll-Rand Research, Inc. under Phase II verification testing on the coal piston feeder. This work was carried out for the US Department of Energy under Contract No. DE-AC21-80MC14600. The results and performance obtained during Phase II is presented herein. The analysis of the results in critical areas such as seals, scraper, rider ring and pressure equalization methods is discussed in detail. The feeder evaluation and assessment with respect to its pressure and throughput capability, power requirements, reliability, etc. is presented. Recommendations are also made for upgrading several areas which will improve the feeder operation. 3 references, 15 figures, 4 tables.

9440 **(DOE/MC/19163—1712) Great Plains ASPEN Model Development: binary interaction parameters and activity coefficient parameters. Final report.** Stern, S.S.; Millman, M.C.; Kirman, J.J.; Nwogu, D. (Scientific Design Co., Inc., New York (USA)). Dec 1984. Contract AC21-82MC19163. 332p. NTIS, PC A15/MF A01; GPO Dep. File Number DE85005410.

The simulation of the various sections of the Great Plains Coal Gasification Plant involves modelling vapor-liquid equilibria and liquid-liquid equilibria that are highly nonideal. The Peng-Robinson equation of state, modified for water, was used in the simulation of most of the process sections. Interaction parameters estab-

lished by regression of literature data, using ASPEN's DRS system, along with interaction parameter values found in the literature, became the database for the simulation. In two of the sections, the Oxygen Plant and the TEG drying of the product SNG, activity coefficient models were used because they gave a better prediction of the phase equilibrium. For the Rectisol unit, which removes hydrogen sulfide from the gas, parameters available from a DOE sponsored contract, Tristate, were used, after verification, for the ASPEN modified version of the RKS. The phases that were predicted using these parameters were checked against literature data and, in most cases, the liquid mole fractions of carbon dioxide predicted by the correlation were within 10% of those reported. A model that would predict phase equilibrium, based on the ionization of Lewis acids and bases and salts, would have been an ideal choice for simulation of the Stretford and Phosam flowsheets. However, only limited temperature dependent liquid activity coefficients data are available in the literature for the ionic species found in the Stretford and Phosam solutions, from which correlation parameters could be obtained by regression. Also, only the flash model can handle this type of calculation; therefore, it was used only to a limited extent in the simulation of the Stretford Unit Absorber. 118 references.

9441 (DOE/METC—84-5, pp 203-211) **Treatment of coal gasification waste water with anaerobic filter technology.** Suidan, M.T. (Univ. of Illinois, Urbana). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

Coal gasification is regarded as one of the more promising technologies for the production of the gaseous fuels needed to supplement dwindling reserves of petroleum and natural gas. Associated with this technology, however, is the production of strongly polluted waste waters characterized by alarming levels of phenols, ammonia, cyanide, thiocyanate and a variety of organic compounds suspected of mutagenic activity. Most coal gasification technologies project the use of aerobic biological treatment processes as the principal means for reducing the organic and inorganic constituents present in such waste waters. Such processes are generally very energy intensive, employing aeration detention times sometimes as high as 10 days. Furthermore, researchers have observed that major organic constituents of coal gasification waste water escape treatment in the activated sludge process even at aeration detention times exceeding six days. The development and evaluation of a unique process for the treatment of coal gasification wastewater are discussed. This process consists of a completely mixed, expandedbed anaerobic filter with granular activated carbon (GAC) serving as an attachment medium. The need for a surface active attachment medium was demonstrated when plastic media packed anaerobic filters failed to affect any measurable degree of treatment of coal gasification waste water.

9442 (DOE/METC—84-5, pp 31-36) **DOE Surface Gasification Environmental R and D.** Headley, L.C. (Dept. of Energy, Morgantown, WV). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial syrfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

The philosophy, goals, and approaches of the Surface Gasification Environmental R and D activities sponsored by the DOE Fossil Energy program are described. The status of those activities are summarized and their relationship to the area of wastewater management and treatment are described.

9443 (DOE/METC—84-5, pp 37-52) **Review of waste water treatment technologies employed in projects submitted to the US Synthetic Fuels Corporation.** Drabkin, M. (Synthetic Fuels Corp., Washington, DC). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

In general, synthetic fuels projects submitted to the US Synthetic Fuels Corporation (SFC) have proposed separate treatment of process and non-process waste waters. However, there have been about as many different process waste water treatment schemes proposed as there are projects. Furthermore, different projects, using the same coal conversion technologies, have proposed handling process waste water using either the zero discharge approach or treatment and discharge under an appropriate permit. Each project has reacted to site-specific considerations to a significant degree in choosing an appropriate waste water treatment technology and there appears to be no commonality in approach. In order to indicate the scope of the various treatment technologies involved, a review of the various SFC projects is presented. Because of the relatively straightforward and well-known treatment technologies required for non-process waste water, further discussion is confined to process waste water treatment.

9444 (DOE/METC—84-5, pp 56-64) **Quench system design impact on waste water treatment.** Lowell, P.S.; Noblett, J.G. (P.S. Lowell and Co., Austin, TX). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

The raw gas from a gasifier contains large amounts of particulates and water. The particulates must be removed as soon as possible because they cause severe problems in all subsequent equipment. The water should be removed as it is a diluent and can cause problems in some downstream process units. A quench and cooling section is often used to remove particulates and water. The design of the quench and cooling sections is discussed as well as how the composition of the water produced in the quench and cooling section may be calculated.

9445 (DOE/METC—84-5, pp 65-72) **Water management system design considerations for Westinghouse-based coal gasification plant.** French, W.E. (Dept. of Energy, Morgantown, WV). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

An overall test plan for waste water and solid waste R and D was developed. Two preliminary concept designs based on zero-discharge and maximum reuse were developed for treating wastewaters from a Westinghouse based synfuels plant. GRI and EPA have initiated efforts to participate in a joint program with METC based on the above-described plan. A description is given of the program and a summary of the program objectives is provided.

9446 (DOE/METC—84-5, pp 73-84) **Environmental systems modeling in surface coal gasification technology.** Headley, L.C.; French, W.E.; Vyas, K.K.; Cheng, D.H.; Brewster, B.S. (Dept. of Energy, Morgantown, WV). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

An environmental systems model is a systems performance model that has been enhanced so as to be able to predict the production and distribution of pollutants and pollutant precursors throughout a process. Environmental systems models are needed for predicting the environmental impact of typical process configurations, optimizing environmental control systems (with respect to configuration, process parameters, cost, and economics), and predicting the environmental impact of systems disturbances. Environmental systems modeling has proved to be a valuable tool for evaluating alternatives in recent years. The primary advantage of mathematical modeling is that it permits rapid and systematic generation and evaluation of alternatives for design, operation, and control. An approach that was initiated recently to develop a systematic method for modeling the production and distribution of environmental pollutants in surface coal gasification processes is discussed. Tools that are appropriate for conducting such modeling work are discussed.

9447 (DOE/METC—84-5, pp 85-95) **Cooling tower emissions from coal gasification plants.** Green, D.A.; Cleland, J.G.; McMichael, W.J. (Research Triangle Inst., Research Triangle Park, NC). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

One of the major streams of environmental concern in coal gasification is the gasifier waste water stream. Several process designs for commercial scale gasification facilities call for the pretreatment of the waste water followed by concentration in cooling towers. Pretreatment consists of filtering the waste, extracting it with solvents to remove the bulk of the organic contaminants, and then stream stripping to remove residual solvents and free ammonia. Pretreated waste water still contains significant quantities of organic and inorganic compounds. One idea for concentrating these compounds is to use the pretreated waste water as makeup water to a cooling tower. Operating at a ratio of makeup to blowdown of 10, the contaminants could be concentrated by a factor of 10 in the blowdown. However, it is not clear that all of the organic and inorganic contaminants will leave the cooling tower by way of the blowdown. Large amounts of potentially hazardous materials could be emitted from the cooling tower in the air effluent. A program directed at determining the level of emissions of potential environmental pollutants from cooling towers at coal gasification plants is described. This study was carried out in a small scale, packed column, which can simulate the behavior of a cooling tower, using a simulated pretreated waste water of controlled composition. In this column the distribution of major components in the effluents of the column as a function of the operating parameters can be determined.

9448 (DOE/METC—84-5, pp 96-106) **Preliminary assessment of the use of stripped gas liquor (SGL) as cooling tower makeup.** Willson, W.G. (Univ. of North Dakota, Grand Forks). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

With a goal of developing data on the nature and treatment/reuse of waste water from the slagging fixed-bed gasification (SFBG) of lignite, a pilot-scale waste water treatment train was operated that featured reuse concentration in a cooling tower. For the baseline test, minimal treatment, using solvent extraction and ammonia stripping, was used to prepare stripped gas liquor (SGL) for use as makeup for a cooling tower. The most cost-effective approach is to provide minimal treatment represented by solvent extraction for organics removal and steam stripping for ammonia and acid gas removal followed by reuse in a cooling tower, without intermediate biological treatment. However, this waste water contains several thousand mg/l of COD--after phenolics and other organics are reduced to low levels. The behavior of these contaminants in a cooling tower with respect to drift, further biological activity, and associated fouling, and their effects on the solubility of dissolved solids is unknown. In order to assess the effectiveness of extraction and stripping alone in treating waste water for cooling tower use, a pilot-scale waste water treatment train was installed that consisted of solvent extraction and ammonia stripping to prepare SGL for testing as makeup in a small cooling tower.

9449 (DOE/METC—84-5, pp 107-119) **Data requirements for environmental modeling of the solvent extraction process.** Faist, M.B.; Phillips, M.W.; Page, G.C. (Radian Corp., Austin, TX). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

The performance and economics of advanced fossil energy processes are currently being evaluated. One important tool in this investigation is the use of computational models which range from detailed single purpose models of a small aspect of the process to large general flowsheet models which simulate the integrated plant. A significant portion of activity in this area has been in the development of a data base for models to predict flows and loading of environmental species of concern, e.g., those species having potentially harmful health and ecological effects. The environmental distribution of certain species is especially important in the design and operation of coal gasification facilities. In the design phase, computational models which comprise the unit operations in the plant are used for heat and material balances, equipment sizing, and cost estimating. Environmental modeling is used to predict the distribution and loading of pollutants entering pollution control processes and the environment. The elements of a solvent extraction unit are examined with an emphasis on the environmental modeling aspects. An overview of the process is given and the chemical species which must be considered are discussed. The data requirements for the environmental modeling of the phenosolvan unit are presented and possible data sources are discussed.

9450 (DOE/METC—84-5, pp 139-151) **Dephenolization of coal-conversion waste waters by means of an aerobic coupling reaction.** Lim, P.K.; Chin, K.C.; Cha, J.A. (North Carolina State Univ., Raleigh). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

The discovery that cuprous chloride can effect specifically the aerobic coupling of aqueous phenol under mild reaction conditions ($T < 60°C$, P/sub O_2/ < 1 atm) has led to the proposal of a novel dephenolization scheme for treating high strength phenolic waste waters. As envisioned in the proposed scheme, aqueous phenols will be converted aerobically and catalytically into insoluble coupling products which may then be easily separated from the waste waters. The recovered solid organics may be disposed of as a fuel. The low cost of cuprous chloride and oxygen, the simplicity of the scheme, and the fuel value of the recovered organics make the scheme highly promising. An on-going study with actual coal gasification waste waters confirms the promising nature of the proposed coupling-dephenolization scheme. Pretreating the actual waste waters with lime, which precipitates the inhibiting carbonate and raises the pH of the waste waters, is shown to increase the rate of the aerobic coupling reaction markedly. Results of a pH variation in the actual waste water study indicate that the optimum pH is in the range 10.0 to 10.50, which is just above the pK/sub a/ value of 9.89 for phenol. Cresols and xylenols were also found to undergo the coupling reaction readily.

9451 (DOE/METC—84-5, pp 152-159) **Linkage between coal gasification waste water processing and resultant sludges: biological and chemical aspects.** Neufeld, R.D.; Moretti, C.; Sykora, J.; Keleti, G. (Univ. of Pittsburgh, PA). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

Earlier research was directed at developing a system of off-the-shelf technologies for the acceptable treatment of METC fixed bed gasification waste waters. The resultant process train involved pH adjustment for precipitation of non-degradable organics, followed by free and fixed ammonia stripping, biological treatment, and activated carbon with/without ozone polishing. The second phase of research investigated the role and limitations of solvent extraction, ozonation, and carbon adsorption for the reduction of non-degradable organic in the overall waste processing train. Solvent extraction removed little if any non-degradable organics when acclimated biosystems were employed. Solvent extraction did, however, greatly enhance the process stability of biosystems, and resulted in a decreased need for supplemental dilution water. The goals of current research are to alter the nature of the waste water processing train so that resultant sludges are acceptable for disposal via RCRA requirements (both current and future), and pose minimal concerns for both human health and environmental health effects. The wastewater processing train is expanded to include cooling tower disposal of treated and partially treated effluents at a nominal 10 cycles of concentration; blowdowns and oxidized blowdowns are being considered as sludges for purposes of this research.

9452 (DOE/METC—84-5, pp 160-167) **Physicochemical treatment studies for coal conversion effluents.** Luthy, R.G.; Campbell, J.R.; Banz, I.; McShea, L. (Carnegie-Mellon Univ., Pittsburgh, PA). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

Several studies are in progress which address different aspects of physicochemical treatment of coal conversion effluents. These studies include estimation of distribution coefficients for solvent extraction processing of coal conversion liquors, evaluation of water reuse in cooling towers, and chemical equilibria in waste water samples. Each of these activities are discussed.

9453 (DOE/METC—84-5, pp 168-177) **Coal gasification waste water physicochemical treatment results: a progress report.** Drummond, C.J. (Dept. of Energy, Pittsburgh, PA). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

The treatment of coal gasification process waste waters requires the integration of several unit operations and unit processes to form a treatment system capable of providing water suitable for discharge to the environment or reuse in the facility. Previous work has emphasized the biochemical oxidation of these waste waters and provided kinetic information and other data useful in the design of larger-scale biological treatment units. Current work stresses the physicochemical treatment operations required for the treatment of these waste waters and the interaction of all unit operations and unit processes in a treatment train. Because of large concentrations of a variety of both inorganic and organic compounds that are present in coal gasification process waste waters, no single waste water treatment operation is capable of removing all of the contaminants to levels acceptable for either reuse or discharge. A series of investigations provides information useful in the design of physicochemical waste water treatment operations and the incorporation of these units in an integrated system for the treatment of coal gasification process waste waters. The investigations include (1) the development of design information for the solvent extraction of coal gasification process waste water, (2) a study of the effect of solvent extraction of this wastewater on the operation of a biological treatment system and subsequent polishing steps, (3) a determination of the effectiveness of the ozonation of biologically treated waste water, and (4) a study of the use of wet air oxidation for the treatment of these waste waters.

9454 (DOE/METC—84-5, pp 178-185) **Characterization of GFETC coal-gasification condensate waters.** Mohr, D.H.; Senetar, J.J.; King, C.J. (Lawrence Berkeley Lab., CA). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—). Contract AC03-76SF00098.

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

The overall objective of this project is to develop and assess physicochemical processing technology suitable for coal-gasification condensate waters. In association with this goal, analytical techniques are being developed to characterize individual organic compounds which contribute substantially to the chemical oxygen demand (COD). Liquid-liquid phase equilibria of various conventional and novel solvents are being investigated so as to identify solvents that can remove large fractions of the COD at low solvent/water ratios. A third area of investigation is a novel approach that combines stripping and solvent extraction to remove and isolate ammonia and acid gases (CO_2, H_2S) from sour waters such as condensate waters from coal conversion. This study was limited to the characterization of the organic compounds in condensate-water samples from the slagging fixed-bed gasifier. High-performance liquid chromatography and gas chromatography were employed to resolve and detect quantitatively organic compounds in condensate waters. A novel technique has been developed to provide qualitative identification of polar organic compounds. Laboratory procedures have been used for quantitative measurement of chemical oxygen demand, organic nitrogen and organic sulfur. In addition, solvent extraction, distillation, and ultrafiltration techniques have been employed to yield information about physical properties of various constituents of the condensate water.

9455 (DOE/METC—84-5, pp 186-194) **Chemical and toxicological evaluation of synfuel waters.** Stamoudis, V.C.; Stetter, J.R.; Flotard, R.D.; Boparai, A.; Haugen, D.A.; Peak, M.J.; Reilly, C.A. Jr. (Argonne National Lab., IL). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—). Contract W-31-109-ENG-38.

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

Aqueous and organic phases of product streams frequently come into contact in synfuels processes. Contacts occur most commonly in gas quench operations and result in the production of a large volume of very complex water/organic mixtures. As a result of contact, chemical transformations may occur that can influence the toxicity of a given material. For example, trace inorganic material in the coal that can appear in the aqueous phase, especially trace-metal ions, can be responsible for chemical changes in the organic compounds in both aqueous and organic phases. The chemical thermodynamics and kinetics of such reactions are strongly influenced by the complex matrix in which they occur. To determine the potential health effects of synfuel waste waters, chemical characterization as well as toxicological evaluation of representative process materials in required. To design effective methods for minimizing adverse effects, relationships must be derived between the process, chemical, and toxicological data. Results of the studies are presented.

9456 (DOE/METC—84-5, pp 195-202) **Fixed-film, fluidized-bed bioreactors for biooxidation of coal conversion waste waters.** Donaldson, T.L. (Oak Ridge National Lab., TN). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—). Contract W-7405-ENG-26.

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

All coal gasification processes will use large quantities of water and generate waste waters that require treatment prior to discharge or reuse. Ultimately, these facilities may face the constraint that no waste waters are to be discharged from the plant boundaries. A major waste water source in all gasification processes is the raw quench condensate. These waste waters are characterized by high concentrations of suspended solids, ammonia, organics (notably phenols), tars, and oils. Treatment of these waste waters will require a train of several treatment operations, including clarification; stripping of tars, oils, and ammonia; removal of organics; and final polishing. An alternative technology for biooxidation of dissolved organics is the fixed-film, fluidized-bed bioreactor. This technology, which is currently under development offers several advantages relative to conventional biooxidation technology. The advantages are presented.

9457 (DOE/METC—84-5, pp 120-130) **EDS coal-liquefaction waste waters: zero-discharge treatability studies.** Robertaccio, F.L.; Kaczmarek, S.A. (Exxon Research and Engineering Co., Florham Park, NJ). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

A research program to verify the commercial readiness of a zero-discharge treatment scheme for waste waters produced by the EDS coal liquefaction process is described. The EDS process converts coal to a range of clean hydrocarbon products by contacting the coal with hydrogen in the presence of a hydrogenated donor solvent. The commercial readiness of this technology has recently been demonstrated for certain coals and operating conditions under a jointly funded government/industry development effort. The effort included testing of two pilot plants: a batch-fed 1 metric ton per day unit called CLPP in 1978, and a 225 metric ton per day, continuous feed prototype unit called ECLP during 1981 and 1982. Waste water characterization and treatability tests were included in both of these efforts. Results are presented of more recent and more detailed treatability studies performed on waste waters collected from ECLP, which is considered to be scaleable to commercial size for those parts of the process represented in ECLP (coal preparation, liquefaction, solvent hydrogenation and fractionation).

9458 (DOE/METC—84-5, pp 131-138) **Extraction of phenolics from SRC-I waste water.** Yen, A.F.; Schwoyer, W.L.; Fergus, R.B. (International Coal Refining Co., Allentown, PA). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

The combined waste water flow of the 6000-tpd SRC-I Demonstration Plant is more than 1000 gpm. Of the total flow, about 400 gpm is heavily contaminated process condensates, laden with high concentrations of phenolics. Evaluation of phenol extraction consists of two steps: (1) determining the feasibility of phenol extraction itself and (2) assessing the effects of phenol extraction on downstream waste water treatment processes, which include ammonia-sulfide stripping, biooxidation, and tertiary treatment of the effluent from the bioreactors. Step 1 has been completed, and Step 2 is still in progress. The major unit processes involved are shown, and the two alternative process configurations are being evaluated. The results obtained thus far are presented.

9459 (DOE/OR/21486—T1) **ASPEN PLUS modeling of the SRC-I Demonstration Plant, Task 1: SRC-I facility summary model report.** Vakil, T.D. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 28 Sep 1984. Contract AC05-84OR21486;AC05-78OR03054. 140p. (DOE/OR/03054—T36). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85004623.

An overall summary model was developed for the SRC-I coal liquefaction demonstration plant using the ASPEN PLUS process simulator. This model includes all major process areas of the plant represented on an overall yield/separation basis. Specifically, the model consists of 34 individual process unit submodels, an estimation submodel for selected plant utilities, and a coal dissolver area yield predictor submodel. The model is intended to provide a preliminary converged solution for interarea terminal stream material balances. These balances can then be used as the basis for individual area process design on a more definite basis. Because of the numerous recycle and interconnecting streams present in the SRC-I plant, such a converged solution would otherwise be extremely difficult and time-consuming. The versatility of the plant summary model is further displayed by its potential use as a precursor to calculate product slates for varying plant operating modes. In addition, if used diligently and with appropriate adjustments, use of the model can be expanded to compare product slates for various coal types. The model incorporates 5 material convergence loops (12 tear streams), 14 process control loops (design specifications), roughly 200 unit operation and FORTRAN blocks, more than 300 streams, and a total of 41 components. 26 references, 7 figures, 27 tables.

9460 (DOE/PC/40091—T11) **Auger analysis of fresh and sulfided bead catalysts to be used for coal liquefaction studies.** Graham, S.W.; Brinen, J.S. (American Cyanamid Co., Stamford, CT. Chemical Research Div.). 1985. Contract AC22-81PC40091. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004848.

Auger analysis was used to determine the effect of changing sulfiding conditions on the surfaces and cross section elemental distributions of the bead catalysts. This study was to supplement the work being conducted at American Cyanamid Company to develop catalysts for coal liquefaction. The samples used in this study were fresh and sulfided bead catalysts and sulfided Shell 324. The bead catalysts contain approximately 3.1% NiO and 10.5% MoO_3 by weight on an alumina support. The Shell 324 also contains NiO and MoO_3 on alumina. The samples were studied by examining the outer catalyst surfaces, examining various points along the cross sections and mapping the cross sections. Differences observed after the various sulfiding treatments include variations in the S, C and Mo content of the outer surfaces and variations in the cross sectional distributions of those elements. 1 reference, 4 figures, 7 tables.

9461 (DOE/PC/40790—T1) **Hydropyrolysis of aromatic ethers.** Williams, J.A. (Utah Univ., Salt Lake City (USA). Dept. of Fuels Engineering). Jun 1984. Contract FG22-81PC40790. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85004298.

This work was concerned with a study of hydropyrolysis reactions of three selected ethers, i.e., dibenzyl ether, phenyl methyl ether (anisole), and diphenyl ether, which are representative of etheric types present in coal-derived liquids. The purpose was to determine the relative susceptibility of such ethers to non-catalytic (thermal) hydrodeoxygenation (HDO), and thereby evaluate the feasibility of applying hydropyrolysis as an alternative process for upgrading of coal-derived liquids. A flow reactor for hydropyrolysis under quantitative conditions was designed and constructed for the purpose of this investigation. Changes in product composition as a function of experimental variables (reaction temperature and space velocity) were investigated and mechanistic aspects of the HDO reactions elucidated. An important component of the reactor flow system developed for this study was an Inconel 600 reactor tube which has a much higher resistance to corrosion than stainless steels. Hydropyrolysis of the aromatic ethers was investigated as a function of temperature (from 400° to 550°C) and liquid hourly space velocity. A constant hydrogen pressure of 1800 psig was used and hydrogen to model ether feed rates were maintained at a ratio of 10:1 (molar) throughout the study. Results are discussed. 90 references, 24 figures, 5 tables.

9462 (DOE/PC/60044—T4) **New and improved dispersion and recovery techniques for slurry phase catalysis. Quarterly report, July 1, 1984-September 30, 1984.** Tarrer, A.R.; Guin, J.A.; Curtis, C.W.; Tatarchuk, B.J. (Auburn Univ., AL (USA). Coal Conversion Lab.). 1984. Contract AC22-83PC60044. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001703.

Effective catalytic processing during direct liquefaction involves a number of physical interactions, two of which are catalytic reactions involving coal or solvent species, and thermal reactions of a coal-coal or a coal-solvent variety. In principle, slurry phase reaction schemes offer the possibility of accentuating the effects of catalysts by providing easy mutual access between coal, catalyst and solvent species when they first enter a heated reaction zone. Since one of the tasks of this study is to evaluate the performance of novel slurry phase catalysts, our efforts during this past quarter were in three areas relevant to this overall goal, namely: (1) preparation of supported and unsupported catalysts with high surface areas and minimal porosities, (2) enhancement and tailoring of the above materials to promote desired activities and selectivities, and (3) evaluation of the above noted materials using model compounds and coal systems to ascertain their performance thereby assisting in the preparation and tailoring of improved catalysts for further evaluations. 29 references, 26 figures, 14 tables.

9463 (DOE/PC/60783—3) **Study of the kinetics of hydrogenation using aged catalysts. Quarterly technical progress report, 1 January 1984-30 Jun 1984.** Schweighardt, F.K. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Jul 1984. Contract FG22-83PC60783. 51p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004373.

Because of vendor delays the autoclave system is a total of 90 days behind schedule. Modifications have been made to the work plan to increase the work load during the fourth quarter to complete Task 2 work on schedule. No experimental effort has been deleted. A Safety Hazards Review has been assembled and documented. Final approval by the Air Products Safety committee to operate the autoclave is anticipated in July. Analytical procedures continued to be developed to quantify feed and reaction products. Capillary gas chromatography methods using a 21 component standard blend of hydrocarbon showed an overall retention time precision of +- 0.002 minutes relative to naphthalene (19.707 minutes) over a range of 1-to-50 minutes. Response factors to quantify weight percent of each component show a precision of +- 0.02 absolute from .1 to 10%, with an accuracy of +- 0.01% at ~ 5 wt%. 18 references, 4 figures, 4 tables.

9464 (ORNL/FMP—84/4) **AR & TD Fossil Energy Materials Program. Quarterly progress report for the period ending September 30, 1984.** Bradley, R.A. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 372p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE85004771.

The objective of the AR & TD Fossil Energy Materials Program is to conduct research and development on materials for fossil energy applications with a focus on the longer-term and generic needs of the various fossil fuel technologies. The program includes research aimed toward a better understanding of materials behavior in fossil energy environments and the development of new materials capable of substantial enhancement of plant operations and reliability. The management of the Progam has been decentralized to DOE Oak Ridge Operations Office (ORO) and the Oak Ridge National Laboratory (ORNL) as technical support contractor. The ORNL Fossil Energy Materials Program Office compiles and issues this combined quarterly progress report from camera-ready copies submitted by each of the participating subcontractor organizations. This report of activities on the program is organized in accordance with a work breakdown structure defined in the AR & TD Fossil Energy Materials Program Plan for FYs 1983 to 1987. It is the intent of the AR & TD Fossil Energy Materials Program to sponsor materials research which is generic to a number of fossil energy technologies. We hope this series of AR & TD Fossil Energy Materials Program quarterly progress reports will aid in the dissemination of information developed on the program.

9465 **(PNL—5118-3) Development of an advanced water-gas shift conversion system. Technical status report: quarterly progress report, August 1-October 31, 1984.** Sealock, L.J. Jr.; Elliott, D.C.; Butner, R.S. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85005411.

The highlight of the quarter was the successful start-up and experimental operation of the Chemical Process Development Laboratory and the experimental system. Eight experimental runs, ranging in length from one to seven hours, were conducted during August and September. Analysis of the data from these low temperature (<300°C) experiments show a low conversion of steam and carbon monoxide to carbon dioxide and hydrogen. The poor performance led to some modifications of the experimental system during the month of October. A full evaluation of these changes awaits the collection of more experimental data during the next quarter. A major focus of the quarter's activities involved experimental work to determine the effect of catalyst solution concentration on the vapor pressure of the system. In order to obtain reasonable reaction rates at suitable pressures (<600 psig), some method for raising the effeconsist oftive reaction temperature without a comensurate rise in system pressure is needed. One means of accomplishing this is to change the temperature-vapor pressure relationship of the catalyst solution. Studies done over a range of catalyst concentrations have led us to the conclusion that concentration effects alone are not sufficient to allow an appreciable increase in reaction temperature. Another potential approach consists of raising the feed gas temperature to 450 to 500°C while operating the reactor itself at low temperatures (250 to 275°C). Designing and installing the equipment to pre-heat the feed gas was the major effort during the last part of this quarter. Other experimental work accomplished during the quarter included an evaluation of the use of potassium carbonate. Potassium carbonate was to be about twice as effective as the sodium carbonate. 8 references, 9 figures.

9466 **Do molecular weight determinations of coal-derived materials give meaningful answers?.** Collins, C.J.; Lietzke, M.H.; Triolo, R. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, TN). *Fuel;* **63**: No. 9, 1202-1205(Sep 1984).

The relation between number-average (M /SUB n/) and weight-average (M /SUB w/) molecular weights has been examined, and it was demonstrated how this can be employed to determine the self-consistency of results obtained for calculating molecular weights of chemically treated coals. The present method of calculation was calibrated against data of Katz et al., then applied to the data of Sun and Burk for g.p.c. fractions of alkylated coals. The newly calculated value for M /SUB w/ (3300) did not agree with Sun and Burk's value of 7882.

9467 **Corrosion of FeCrAl, FeCrAlY, and FeCrAlHf alloys in high temperature H_2-H_2O-H_2S environments.** Huang, T.T.; Lin, Y.C.; Pfender, F.; Shore, D.S. (Corrosion Research Center, University of Minnesota, Minneapolis, Minnesota). *Journal of the Electrochemical Society;* **131**: No. 9, 2191-2196(Sep 1984).

High temperature corrosion plays an important role in the development of many combustion and coal gasification processes. In gasification processes, various grades of fuel gas are produced by the reaction of coal with steam and oxygen at high temperatures. The resulting gas contains hydrogen, steam, carbon dioxide, carbon monoxide, and some methane. It also contains low levels of hydrogen sulfide and other impurities derived from the coal. Reaction of such impurities with alloys is a common cause of corrosion. For example, sulfidation has been shown to have a devastating effect on many metallic structural components in coal gasification environments. In a typical coal gasification process, the atmosphere has a low oxygen activity, but relatively high activities of sulfur, carbon, hydrogen, and nitrogen. It is becoming increasingly apparent that available stainless steels and superalloys do not have adequate corrosion resistance in such environments. To survive, an alloy must form a compact, protective scale, which acts as a barrier to the penetration of sulfur or carbon to the metal. All stainless steels and superalloys form oxide scales in these environments, but the scales offer widely differing degrees of protection. Many factors may contribute to the less-thanoptimum performance of the oxide scales. Much previous work has been carried out to evaluate the performance of alloys in environments that simulate to varying degrees the expected exposure conditions in coal gasifiers.

9468 **Conversion of bituminous coal in CO/H_2O systems, 2. pH Dependence.** Ross, D.S.; Blessing, J.E.; Hum, G.P.; Nguyen, Q.C. (SRI International, Menlo Park, CA). *Fuel;* **63**: No. 9, 1206-1210(Sep 1984).

Under CO/H_2O systems at initial pH values > 12.6, an Illinois No. 6 coal, PSOC-26, was converted to a fully pyridine-soluble product, with benzene and hexane solubilities of 50% and 18%, respectively. The product gases were H_2 and CO_2. However, the expected H_2/CO_2 ratio of 1.0 based on the water gas shift reaction was not observed, but the deficit in hydrogen was found to be increased hydrogen content of the coal product. 95% coal carbon recovery and good hydrogen balances were obtained, and the coal products were found to be very similar to those from conventional tetralin systems. The results suggest an efficient base-catalysed process, and that CO/H_2O systems are useful for coal studies.

9469 **Conversion of bituminous coal in CO/H_2O systems 3. Soluble metal catalysis.** Ross, D.S.; Hum, G.P.; Nguyen, Q.C. (SRI International, Menlo Park, CA). *Fuel;* **63**: No. 9, 1211-1213(Sep 1984).

The oxyanions of the highest oxidation states of several transition metals, including W, Mo, Cr and Mn, were found to catalyse the liquefaction of Illinois No. 6 coal in CO/H_2O systems at 400°C. Unlike the high pH (>12) required in the base-catalysed system, the effective range for these metal-mediated conversions extend down to pH<5.0. The benzene-soluble product was found to have a higher H/C ratio than the starting coal, and the metals were reduced to water-insoluble, lower oxidation states during conversion. A chain scheme is suggested as an explanation for the data.

9470 **Coal flash pyrolysis 4. Polymethylene moieties in coal macerals.** Calkins, W.H.; Bloomquist, C.A.A.; Dyrkacz, G.R.; Housepian, B.K.; Ruscic, L. (Central Research and Development Department, E.I. du Pont de Nemours and Company, Experimental Station, Wilmington, DE). *Fuel;* **63**: No. 9, 1226-1229(Sep 1984).

An analysis for polymethylene moieties in purified coal macerals has shown the $(CH_2)_n$ content, by a liquefaction-^{1}H N.M.R. method, to be highest in exinite macerals and lower in vitrinite and inertinite macerals. From any particular coal, the $(CH_2)_n$ content of the vitrinite was higher than the inertinite but lower than the exinite. Pyrolysis of these macerals gave ethylene yields proportional to the $(CH_2)_n$ content.

9471 Coal pyrolysis at high temperatures and pressures. Tamhankar, S.S.; Sears, J.T.; Wen, C.Y. (Department of Chemical Engineering, West Virginia University, Morgantown, WV). *Fuel;* **63**: No. 9, 1230-1235(Sep 1984).

At high temperatures (>1100°C), pyrolysis of coal plays an increasingly important role in the overall coal conversion process. This paper presents experimental data on the extent of pyrolysis of coal at 800-1600°C. In addition, the effects of the following parameters are examined: gaseous environment (N_2, CO_2 and H_2O), pressure (1-20 atm), particle size, moisture content and type of coal. Previous data on some of these parameters are non-existent. A unique TGA apparatus constructed for this work allows high heating rates (10^3-$10^5 Cs^{-1}$) due to the direct radiation heating. In all the gaseous environments, a plateau in per cent pyrolysis is noticed at 1200-1400°C followed by a sharp increase in the amount of pyrolysis as the temperature is raised. This is found consistent with the three-stage mechanism proposed for the evolution of volatiles. In CO_2 and steam environments, there is slightly less pyrolysis than in pure nitrogen, while considerably more pyrolysis is noted for predried coal and for smaller particle sizes. The results suggest a strong influence of secondary volatile reactions on the extent of pyrolysis. Pyrolysis in steam at 800-900°C shows an increase with pressure similar to that reported for pyrolysis in hydrogen. Finally, gasification rates of chars immediately following the pyrolysis are found to be much higher than those of chars prepared separately and then reacted. These results suggest morphological rearrangements and crystallization effects.

9472 Light scattering studies of the stability of liquid fuels. Li, N.C.; Ge, J.; Hazlett, R.N.; Yaggi, N.F. (Department of Chemistry, Duquesne University, Pittsburgh, PA). *Fuel;* **63**: No. 9, 1285-1289(Sep 1984).

Storage stabilities of upgraded coal-derived liquids (H-coal and SRC-II), JP-5 jet fuels derived from petroleum and oil shale, and a petroleum-derived diesel fuel were compared using laser light scattering measurements. The most severely hydrotreated coal-derived liquids have stability characteristics comparable to the jet fuels derived from petroleum and oil shale. Fuel degradation was monitored in the presence of added specific heteroatomic compounds. Very pronounced enhancement of light scattering intensity has been observed for coal-derived liquids containing the following additives: 1. phenol+ pyridine+Cu; 2. 2,6-di-tertbutylphenol (DTBP)+pyridine+Cu; 3. phenol+dimethylquinoline, (DMQ)+Cu; and 4. 2,5-dimethylpyrrole (DMP)+thiophenol. Previous studies have shown that phenolic oxidative coupling is an important reaction responsible for the ageing of coal-derived liquids and this observation is confirmed here. Pyridine and DMQ complexed with Cu are shown to be effective catalysts for oxidative coupling. DMP by itself is deleterious to fuel stability, in that it promotes sediment formation and light scattering. During accelerated ageing of upgraded H-coal in the presence of DMP a sediment formed with empirical formula C_7H_9NO /SUB 1.3/ , which was further characterized by solid-state C 13 n.m.r. and X-ray photoelectron spectroscopy.

9473 The Hanna, Wyoming, underground coal gasification field test series. Bartke, T.C.; Gunn, R.D. (Coal Conversion Program, U.S. Department of Energy, Laramie, WY). *ACS Symposium Series;* **79**: No. 226, 4-14(1983).

Six field tests of in-situ coal gasification have been conducted by the Department of Energy's Laramie Energy Technology Center Near Hanna, Wyoming with typical gasification rates of 100 tons of coal per day for continuous operation of about 30 days. This paper presents an overview of the Hanna field tests.

9474 Review of underground coal gasification field experiments at Hoe Creek. Thorsness, C.B.; Creighton, J.R. (Lawrence Livermore National Laboratory, Livermore, CA). *ACS Symposium Series;* **79**: No. 226, 15-43(1983). Contract W-7405-ENG-48.

LLNL has conducted three underground coal gasification experiments at the Hoe Creek site near Gillette, WY. Three different linking methods were used: explosive fracturing, reverse burning and directional drilling. Air was injected on all three experiments and a steam/oxygen mixture during 2 days of the second and most of the third experiment. Comparison of results show that the linking method didn't influence gas quality. The heat of combustion of the product gas was higher with steam/oxygen injection, mainly because of reduced inert diluent. Gas quality was generally independent of other operating parameters, but declined from its initial value over a period of time. This was due to heat loss to the wet overburden and extensive roof collapse in the second and third experiments.

9475 Large block experiments in underground coal gasification. Hill, R.W.; Thorsness, C.B. (Lawrence Livermore National Laboratory, Livermore, CA). *ACS Symposium Series;* **79**: No. 226, 57-65(1983). Contract W-7405-ENG-48.

The process of in-situ coal gasification, while extremely simple in concept, is complicated in practice because, as the burn proceeds, the reacting volume is constantly changing geometry. In addition, the process takes place underground where it is extremely difficult to observe in detail. The five large block experiments described here were planned as a series of gasification experiments, each of which was to be terminated at a fairly early stage of cavity development and examined by postburn excavation. The experiments included 1:1 and 3:1 steam:oxygen injection at two different flow-rate schedules, an air-injection burn, and a test of the controlled retracting injection point (CRIP) system. The results indicate that the underground coal gasification process at this location is insensitive to changes in steam:oxygen ratios or flow rate over the range used. The burn cavities were all mostly filled with rubble and thermally altered coal.

9476 The role of instrumentation in UCG process development. Hommert, P.J. (Sandia National Laboratories, Albuquerque, NM). *ACS Symposium Series;* **79**: No. 226, 77-88(1983).

Underground coal gasification field test results obtained since 1976 are reviewed, illustrating the important role that the UCG process feature of a varying reactor geometry has on resource recovery and gas quality. The different instrumentation used on these tests is then reviewed, particularly as to its effectiveness or lack of in defining process geometry. Instrumentation such as thermocouples, HFEM, acoustic and surface resistivity are discussed with respect to concept, cost, resolution, data acquisition and data analysis. Results indicate that when instrumentation is appropriately deployed it can provide significant insight into the dynamics of cavity growth.

9477 Modeling the underground coal gasification process: part 1-Reverse combustion linking. Krantz, W.B.; Gunn, R.D. (Department of Chemical Engineering, University of Colorado, Boulder, CO). *ACS Symposium Series;* **79**: No. 226, 89-97(1983).

Prior to underground gasification of a coal seam, it is necessary to provide one or more relatively narrow links or high permeability paths between the injection and production well bores. These links permit high oxidant injection flow rates during gasification and minimize the effect of condensation of tars from the product gas. Reverse combustion effects linking by a low temperature carbonization process whereby the permeability of the coal is enhanced by driving off the water and volatile matter. This paper reviews modeling studies of reverse combustion linking which seek to explain the physics of the process, predict the number, diameter and propagation velocity of the links formed, identify limitations in this process, and suggest process improvements whereby reverse combustion linking can be made more predictable and reliable.

9478 An analysis of permeation models for in situ coal gasification (forward combustion mode). Haynes, H.W. Jr. (Chemical Engineering Department, University of Wyoming, Laramie, WY). *ACS Symposium Series;* **79**: No. 226, 98-107(1983).

The permeation models applicable to in situ coal gasification (forward combustion mode) are analyzed and compared in terms of their underlying assumptions. Predictive capability generally diminishes in the order. Unsteady-state models (I) - Steady-state models (II) - Equilibrium Gasification models (III) - Constrained Mass Balance Models (IV); however, computational complexity decreases in the same order. Only models (I) and (II) are applicable under con-

ditions removed from thermodynamic equilibrium (e.g., at high water influx ratios) where reaction kinetics must be incorporated into the model. Model II, the steady-state model, has the additional desirable feature of requiring only a modest computational effort.

9479 **Modeling the underground coal gasification process: part II--water influx.** Krantz, W.B.; Gunn, R.D. (Department of Chemical Engineering, University of Colorado, Boulder, CO). *ACS Symposium Series;* **79**: No. 226, 121-128(1983).

Water influx plays a pivotal role in the underground coal gasification (UCG) process. The natural water influx is an inherent advantage of the UCG process since it promotes the steam/char gasification reaction without the need for injection of high quality surface water. However, the vaporization of excessive water influx robs heat needed to promote the endothermic gasification reactions. Water-influx modeling studies seek to identify the principal mechanisms responsible for water influx, to predict the instantaneous water influx, to prescribe laboratory methods for characterizing the water influx properties of a UCG site, and to suggest operating strategies whereby the adverse effects of excessive water influx can be minimized. This paper then reviews the state-of-the-art in water-influx modeling studies.

9480 **Modeling the underground coal gasification process: part III-subsidence.** Krantz, W.B.; Gunn, R.D. (Department of Chemical Engineering, University of Colorado, Boulder, CO). *ACS Symposium Series;* **79**: No. 226, 129-138(1983).

The cavity created by underground coal gasification (UCG) will be associated with some degree of subsidence in the overburden above the cavity. Subsidence refers to the adjustment in the earth which is made in response to the creation of a subsurface cavity. This subsidence can take a variety of forms, some of which can cause considerable damage both to the environment and to the UCG process and associated equipment. This article reviews the physical and geometrical factors which must be considered in subsidence modeling and the empirical, analytical, numerical, and phenomenological approaches used to model subsidence in UCG. Finally, the results of applying these subsidence models to UCG field tests are reviewed.

9481 **Water quality monitoring at the Hoe Creek test site: review and preliminary conclusions.** Wang, F.T.; Mead, S.W.; Sturmer, D.H. (Lawrence Livermore National Laboratory, Livermore, CA). *ACS Symposium Series;* **79**: No. 226, 154-173(1983).

It has been shown that underground coal gasification (UCG) may introduce a broad range of residual products into the groundwater of a coal aquifer. Sorption of many contaminants by the coal itself is an important factor in restricting the migration of these contaminants in the groundwater. However, our field studies at the Lawrence Livermore National Laboratory (LLNL) Hoe Creek site in northeastern Wyoming have shown that sorption of organic compounds by coal is not as effective as expected, perhaps because the coal surface area is limited. Furthermore, if severe roof collapse has taken place during gasification, non-coal aquifers located above the gasified coal seam may become interconnected with the cavity. Contaminants may enter these non-coal aquifers, in which sorption is even less effective. The Hoe Creek II and III experiments have enabled us to study the contamination of a sand aquifer located above a gasified coal seam in a hydrological recharge area. The preliminary results indicate that the water in the overlying sand aquifer is much less contaminated with organic compounds than that in the gasified coal aquifer.

0106 Properties

REFER ALSO TO CITATION(S) 0106009472, 9522, 9528, 9548, 9549, 10150

9482 **(CONF-850211—2) Preparation of premium coal samples at Argonne National Laboratory.** Vorres, K.S. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004040.

From Annual meeting of the Society of Mining Engineers; New York, NY, USA (24 Feb 1985).

The purpose of the Program is to provide the coal science community with high quality, well characterized samples of carefully selected coals over long periods of time. These samples should be useful for standards of comparison and correlation. The variations within coal seams, the perishable nature of the coal particles, the irreversible nature of some changes like drying, and the need for consistent samples over long periods of time all led to a very detailed consideration of each step in the process from the initial selection of a coal to the reporting of the results from the work on the samples. The program elements consist of the selection, collection, transport, processing, analysis, distribution and dissemination of information about these premium samples. The plans for information dissemination include computerized access to a data base containing the sample availability, properties and a bibliography of research on these samples. The interaction of the basic coal science community will be promoted by periodic conferences at ANL to review the results of the work done on the premium samples.

9483 **(DOE/PC/70781—T1) Stability, rheology and flow of coal-water mixtures. Quarterly progress report, September 1-November 30, 1984.** Turian, R.M. (Illinois Univ., Chicago (USA). Dept. of Chemical Engineering). [1984]. Contract FG22-84PC70781. 2p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003973.

This is the first quarterly progress report on the subject DOE grant since the starting date of September 1, 1984. During the present reporting period we have been occupied with the details of starting up of the project. Activities during this period have included hiring graduate research assistants for the project, providing them with full details of the research and its objectives, design and construction of research equipment, purchase and installation of coal slurry preparation equipment, setting up of newly purchased research instruments, and testing and calibration of instruments and equipment. Our objective is to test and hopefully establish a definitive method for measurement of yield stress as an intrinsic property (as contrasted to a rheological model parameter) which will then be related to the microstructure of the coal suspension. We have also calibrated the new capillary tubes using Newtonian standards, and tested them extensively using stabilized titanium dioxide dispersions and the laterite slurries discussed above. Among major new instruments that are being set up are the mercury porosimeter and the BET adsorption apparatus. We hope to start preliminary tests on concentrated coal suspensions during the coming period.

9484 **(NR—83/175) Characterization of coal samples with scanning electron microscopy combined with X-ray microanalysis.** van der Burgh, N.; Timmer, J.M. (Nijverheidsorganisatie TNO, Delft (Netherlands). Hoofdgroep Maatschappelijke Technologie). Sep 1983. 16p. (In Dutch). Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Delft, Netherlands.

Characterization related to mineral compounds of five coal samples was performed with scanning electron microscopy combined with energy dispersive X-ray microanalysis. This characterization concerned quantitative analysis of inorganic materials, but also type and distribution of minerals and macerals. The relation minerals/macerals was different in each sample. For this investigation only polished specimens of the 3 mm-samples were used.

9485 **(NR—84/47) Spontaneous heating of coal. Evaluation report on the research performed in 1983.** Schmal, D.; Heemskerk, A.H.; Kok, A.; van Heuven, J.W. (Nijverheidsorganisatie TNO, Delft (Netherlands). Hoofdgroep Maatschappelijke Technologie). Mar 1984. 15p. Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Delft, Netherlands.

A review is given of the results and their evaluation of investigations on spontaneous heating of coal. The research programme consists of three parts: (1) field measurements; (2) laboratory measurements and (3) development of a model. Methods were developed to estimate the tendency of spontaneous heating and losses in calorific values of coal piles on the basis of measurements of gas composition and its flow velocities in the pile. Losses calculated from measurements vary between 0.1. and 4% per year de-

pending on storage conditions. Losses in calorific value in piles having temperatures of about 80 deg C can be as high as 15% in one year. Furthermore a method was developed to predict the spontaneous heating behaviour of a coal pile on the basis of laboratory measurements and a mathematical model. As follows from a comparison of the calculating results with those of field experiments, it now gives semi-quantitative results. It can be concluded that the most important parameters are: the porosity of the pile, the process of evaporation and condensation of coal moisture, temperature of the coal at the beginning of storage and reactivity of the coal towards oxygen adsorption. With the knowledge obtained so far about the importance of the different parameters, it is possible to give general recommendations about storage conditions and measures to prevent spontaneous heating for existing and new coal piles.

9486 **(SVF—139) Composite pellets of coal.** Ryk, L.; Drugge, R.; Forsmo, S.; Kristensen, V. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Jun 1983. 52p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750199.

The present publication reports on initial experiments on production of pellets of coal with sulphur binding additives and with feasible physical properties. The pellets are designed for fire grates. The experiments included pelletizing trials with Polish and American coals, including drying and determination of abrasion resistance as well as introductory combustion tests. The best results concerning strength were obtained by the addition of 0.1-0.2 percent of an organic binder, CMC, (carboxymethyl cellulose). The porosity of the pellets was equal to that of iron ore pellets, but the strength was lower. Probably they will be able to withstand handling during normal transport and combustion. The addition of limestone, dolomite or slaked lime promoted adsorption of sulphur to ash during combustion, the highest adsorption rate being 64 percent of the sulphur bound to the ash. An evaluation of the costs indicates that composite pellets can be of interest, compared with desulphurizing of stack gas and also compared with the use of low sulphur coal, at production levels of above 10 tons coal per hour (about 40 MW output). Specifications for composite pellets should not deviate significantly from those for lump coal. Conditions concerning the stack gas which can be expected in the foreseeable future are believed to be fulfilled when using composite pellets, based on coal easily available on the market.

0108 Waste Management

REFER ALSO TO CITATION(S) 0108009441, 9442, 9444, 9445, 9447, 9448, 9449, 9450, 9451, 9452, 9453, 9454, 9455, 9456, 9457, 9458

9487 **(DOE/ET/15492—T61) Laboratory/Bench scale testing and evaluation of APT dry plate scrubber. Nineteenth quarterly report, September 1-November 30, 1984.** (Air Pollution Technology, Inc., San Diego, CA (USA)). 24 Dec 1984. Contract AC21-80ET15492. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005217.

Progress accomplished during the quarter ending December, 1984, is briefly summarized. The objective of this project is to conduct a bench scale experimental evaluation of the dry plate scrubber (DPS) at high temperature and pressure to determine its potential for controlling particulate and alkali vapor emissions from PFBC processes. The major technical objectives for this quarter were to: (1) Complete HTP/DPS experiments; (2) Complete process design; and (3) Complete AFBC/DPS experiments. The main gas heater element was received and installed. The main air heater was received and installed. Experiments have not yet been started. Alkali vapor concentration in the AFBC slip stream was measured. One test was carried out to observe dust deposition with particules pre-conditioned. 1 figure, 2 tables. (DMC)

9488 **(DOE/FC/10225—1650) On-site field tests for study of low-rank western coal fly ash.** Dahlin, R.S.; Marchant, G.H. Jr.; Gooch, J.P.; Bickelhaupt, R.E.; Sears, D.R. (Southern Research Inst., Birmingham, AL (USA)). Aug 1984. Contract AC18-80FC10225. 98p. NTIS, PC A05/MF A01; GPO Dep. File Number DE84017054.

This report describes a series of field and laboratory studies of the characteristics and control of fly ash emissions from low-rank Western coals. Field tests were conducted at three pulverized coal-fired utility boilers burning low-rank Western coals. Each field test included: measurements of the mass concentrations of fly ash suspended in the flue gas at the inlet and outlet of the particulate collector and determination of the overall fly ash collection efficiency, measurements of the inlet and outlet particle size distributions of the fly ash and determination of the fractional collection efficiency, measurements of the electrical resistivity of the ash, documentation of the operating conditions of the boiler and the particulate collector, analysis of the important flue gas components, and collection of coal and ash samples for various laboratory studies. The laboratory work that was done in conjunction with each field test included: proximate and ultimate analyses of the coal, chemical analysis of the fly ash, measurements of ash resistivity as a function of temperature and flue gas environment, and detailed microanalytical characterization of individual ash particles. The bulk physical and chemical characteristics of these ashes are described in detail in the report, and microanalytical characterizations of individual ash particles are presented. The latter show some very interesting correlations between elemental composition and particle size and between one element and another. The potential uses of these data are discussed, and areas that require further investigation are identified. It is concluded that the fly ash emissions from low-rank Western coals can be effectively controlled with existing technology if the particulate collector is properly designed and operated; ash resistivity can be predicted; a better understanding of ash-flue gas interactions is needed. 33 references, 46 figures, 17 tables.

9489 **(DOE/FE/60148—T7) Sorbents performance testing, regeneration and attrition. Monthly progress report, January 1, 1983-January 31, 1983.** (NOXSO Corp., Paducah, KY (USA)). 21 Feb 1983. Contract AC22-82FE60148. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003784.

This report contains the results of a series of tests designed to determine the effect of absorption temperature on the rate of sorbent attrition. Two sorbent materials were tested over five cycles of absorption/regeneration at absorption temperatures of 225, 250, and 350°F, respectively. Each sample was then tested in the Air Jet Attrition Apparatus (AJAA) to determine its relative rate of attrition. In addition to these test results, photographs taken with a scanning electron microscope are provided to show the surface structure of the two different sorbent materials used in these series of tests. 5 figures, 3 tables.

9490 **(DOE/FE/60148—T8) Sorbents performance testing, regeneration and attrition. Monthly progress report, December 1, 1982-December 31, 1982.** (NOXSO Corp., Paducah, KY (USA)). 22 Jan 1983. Contract AC22-82FE60148. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003783.

This report covers work accomplished during the period December 1, 1982 through December 31, 1982. The work included: testing of two different sorbents over five cycles at elevated temperature to examine attrition rate as a function of the temperature in the absorber, testing of a new sorbent material supplied by W.R. Grace and Co. in the fluid bed absorber, set-up and preliminary testing of the Dupont 400 Photometric H_2S Analyzer, and set-up and preliminary testing of the Air Jet Attrition Test Apparatus.

9491 **(DOE/MC/14617—T2) Denitrification and desulfurization of combustion gases. Quarterly technical progress report No. 2, December 18, 1980-March 17, 1981. Draft.** Desai, N.J.; Li, K.T.; Yang, R.T. (State Univ. of New York, Buffalo (USA). Dept. of Chemical Engineering). 1981. Contract AC22-80MC14617. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004224.

The major achievement has been in the success in developing the new, two-step NO splitting process. The first step involved absorption of NO and O_2 with sodium ferrite ($Na_2O.Fe_2O_3$) pellets at ca. 400°C. The nitrated pellets were decomposed at 700 to 750°C, when large amounts of N_2 were formed. At 750°C, the fractional conversion of the originally absorbed NO to N_2 reached a

level of 70%. This level is higher than that which can be achieved with the best known catalysts in the direct decomposition process with deep packed-beds. Direct catalytic decomposition with sodium ferrite was also studied. The reaction is first order with respect to NO. This catalyst is far superior than plain iron oxide. In the study of the Fe_2O_3 catalyzed sulfation of limestone, it was found that Fe_2O_3 catalyzed the chemical rate, but retarded the pore diffusion rates. This result is preliminary and awaits further experimental study. 5 figures.

9492 **(DOE/MC/14617—T3) Denitrification and desulfurization of combustion gases. Quarterly technical progress report No. 3, March 18-June 17, 1981.** Desai, N.J.; Li, K.T.; Ramanathan, K.; Yang, R.T. (State Univ. of New York, Buffalo (USA). Dept. of Chemical Engineering). 1981. Contract AC22-80MC14617. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004209.

A strong catalytic effect on the SO_2 absorption rate by Fe_2O_3 coated on dolomite (Tymochtee) has been established. A small amount of Fe_2O_3 coating (of the order of 1%) can increase the SO_2 absorption rate by 60%. The coating procedure is rather simple and readily applicable, e.g., it can be done by spraying the uncalcined sorbent with an iron salt solution before feeding to the fluidized-bed combustor. The catalytic process is a selective one, depending on the type of the limestone. It is our preliminary observation that the coated Fe_2O_3 also blocks the pores and hence only works for stones with porosities and pore sizes greater than certain levels. In the development of the new, two-step NO decomposition process, the catalyzed rate equation for NO decomposition on sodium ferrite has been established as $r = k[NO]/(1 + K[O_2])$, where r is the specific rate expressed in moles/s/cm^2, k rate constant in cm/s and K the equilibrium absorption constant of O_2 on the surface. Comparing with the Fe_2O_3 surface, at 700°C, k for the iron salt is 2 to 4 times higher and K, which is indicative of the O_2 inhibition effect, is about 4 times higher. 11 references, 8 figures.

9493 **(DOE/MC/14617—T4) Denitrification and desulfurization of combustion gases. Quarterly technical progress report No. 1, September 18-December 17, 1980.** Desai, N.J.; Li, K.T.; Yang, R.T. (State Univ. of New York, Buffalo (USA). Dept. of Chemical Engineering). 1981. Contract AC22-80MC14617. 15p. NTIS, PC A02/MF A01;.1; GPO Dep. File Number DE85004225.

The major effort during the first quarter was on the design, construction and debugging of the apparatus. This effort has been completed ahead of the original schedule. Adequate samples have been procured. Some preliminary experiments were performed on denitrification. A complete thermogravimetric (TG) reactor and a packed-bed (PB) reactor were built. The PB reactor was used to gather some preliminary results on the two-step NO decomposition process, using an iron oxide-fly ash sintered sorbent. The results were compared with the direct NO decomposition on the same sorbent (as a catalyst in this case). The yield of N_2 in the two-step process was about 10 times higher than that by direct catalyzed splitting. The results are preliminary and further studies are in progress. 3 references, 4 figures.

9494 **(DOE/MC/14617—T5) Denitrification and desulfurization of combustion gases. Quarterly technical progress report No. 5, September 18-December 17, 1981.** Desai, N.J.; Ramanathan, K.; Yang, R.T. (State Univ. of New York, Buffalo (USA). Dept. of Chemical Engineering). [1984]. Contract AC22-80MC14617. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004213.

A complete kinetics study of iron oxide catalyzed sulfation has been performed. From the kinetics data, a calculation has been made to estimate the improvement of the performance of a fluidized-bed combustor using Fe_2O_3 coated sorbent. For Tymochtee dolomite, with 1.08% (by weight based on CaO contained in sorbent) Fe_2O_3 coated on uncalcined stone, it has been shown using the MIT FBC model that for 90% sulfur retention, a 40% reduction of the sorbent requirement is achieved over the uncatalyzed case. In other words, Ca/S ratio = 2.5 for the uncoated stone, whereas Ca/S = 1.5 for the coated case, for the same sulfur retention. Although the Fe_2O_3 coating procedure works well for Tymochtee dolomite, it has an inhibiting effect on the Greer limestone. This is a result of plugging of pore mouths. A complete study (both modeling and experimental) has been done to show the interplay of the two opposing effects: increase in chemical rate by Fe_2O_3 and decrease in pore diffusion rate due to plugging. A complete study of the kinetics of the reaction between Greer limestone and NO under combustion gas conditions has been made. The reaction becomes quite reversible, i.e., the NO concentration in combustion gas approached the equilibrium value, at slightly above 400°C. The thermodynamic equilibrium values have been measured with TGA. Basic kinetics data were gathered, which may be used for reactor design. 8 references, 35 figures, 10 tables.

9495 (DOE/METC—84-5, pp 53-55) **Commercial waste water design and economic considerations.** Ford, D.L. (Engineering Science, Inc., Austin, TX). Mar 1984. NTIS, PC A11/MF A01. File Number DE84009294. (CONF-830643—).

From 3. biennial synfuels wastewater workshop; Morgantown, WV, USA (15 Jun 1983).

Some of the more pertinent process considerations in treating the liquid waste waters discharged from synthetic fuels plants are discussed. Two major subtopics are considered: the basic design criteria and considerations involved in treating the liquid effluents from such facilities, and the overall economics involved with waste water treatment. Pretreatment considerations are also discussed. Such factors as waste water characterization, waste water characteristics, process simulation studies, scale-up factors, capital costs, operational and maintenance cost tradeoffs, and the overall cost effectiveness of selected processes are discussed.

9496 **(DOE/PC/60262—T10) Advanced combined NO/sub x//SO/sub x/ removal system. Monthly technical progress report, November 3-November 30, 1984.** (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). 12 Dec 1984. Contract AC22-83PC60262. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004543.

The system is an advanced process for simultaneously removing NO/sub x//SO/sub x/ and particulates from flue gas. The process utilizes a novel contractor/filter with a moving bed of copper oxide absorber-catalyst. By adding NH_3 to the flue gas, NO/sub x/ as well as SO/sub x/ removal can be obtained. The same contactor/filter also removes particulates from the gas. The project objectives are simultaneous removal of greater than 90% of the NO/sub x/, 90% of the SO/sub x/, and 99.9% of the particulates. During this reporting period (1) the preliminary operational phase checkout tests using unimpregnated support were successfully completed and (2) the first tests of NO/sub x//SO/sub x/ removal using the Davison catalyst were carried out.

9497 **(DOE/TIC—3402) Flue gas desulfurization and denitrification: a bibliography.** Grissom, M.C. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Jan 1985. 818p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE84012321.

This bibliography contains 3920 references including abstracts, to information on the technology of flue gas desulfurization and denitrification. These references and others are included in the Department of Energy's Energy Data Base (EDB) through December 1983. The references cover research reports, journal articles, books, patents, theses, and conference papers from world-wide sources and were collected in support of DOE's research programs. The subject search was formulated to select information dealing primarily with flue gas cleaning of sulfur and nitrogen compounds. Current citations on flue gas cleaning are announced semimonthly in the bulletin Coal Preparation and Pollution Control. The abstracts were arranged by listing reports first in alphanumerical order by report number, followed by nonreports in reverse chronological order. Five indexes, each preceded by a brief description, are provided: Corporate Author, Personal Author, Subject, Contract Number, and Report Number.

9498 **(INTRON—83228) Mixtures of fly ash, gypsum, lime and cement for road base construction: a laboratory investigation.** (INTRON B.V., Maastricht (Netherlands)). Dec 1983. 42p. (In Dutch). INTRON B.V., Maastricht, Netherlands.

INTRON, an independent research institute in the Netherlands, investigated the technical properties of fly ash-lime-cement-gypsum mixes to be applied in civil technical works, especially road construction. In the experimental investigation the following materials were used: pulverized coal fly ash, lime, blast furnace cement type A, phosphoric acid gypsum (abb.: fosfogypsum), and flue gas desulfurization gypsum (abb.: rogypsum). With these materials several road base mixes were composed, whose properties such as strength development and frost-thaw resistance were investigated.

9499 **(INTRON—83234) Possibilities for the application of dry bottom ash.** van der Wegen, G.J.L. (INTRON B.V., Maastricht (Netherlands)). Mar 1984. 113p. (In Dutch). INTRON B.V., Maastricht, Netherlands.

A technical study has been performed on dry bottom ash from Dutch pulverized coal fired electric utility plants. The study was aiming to: characterize bottom ashes from the existing coal fired power plants; investigate present applications of bottom ash in the Netherlands; look for other applications of bottom ash. A literature study has been performed and interviews have been taken to evaluate the knowledge on this subject. From this evaluation a number of attainable utilizations of dry bottom ash have been selected for experimental research. Seven samples of dry bottom ashes from the three Dutch pulverized coal firing electric power plants have been characterized regarding their chemical composition, particle size distribution, density, water absorption and shape and surface texture of the grains. The carbon content of the dry bottom ash descending from the power plant PLEM appeared to be significantly less than that for the other two power plants (PNEM and PGEM). Microscopic investigation revealed that dry bottom ash possesses two extreme appearances: grains originated by sintering of fine particles (open structure with coarse pores, irregular surface and shape); grains originated by solidification of molten particles (closed and smooth surface structure). Three of these seven samples have been investigated regarding utilization in: concrete floor blocks spanning prestressed concrete beams; concrete building blocks; structural lightweight concrete; base and subbase materials for road constructions.

9500 **(INTRON—83248) Artificial aggregates for concretes produced from fly ash.** van der Wegen, G. (INTRON B.V., Maastricht (Netherlands)). Apr 1984. 48p. (In Dutch). INTRON B.V., Maastricht, Netherlands.

An experimental research has been performed to compare the behaviour of three kinds of artificial aggregate produced from fly ash with natural river gravel as a coarse aggregate for concrete. For each of the main types of artifical aggregates from fly ash one brand has been selected for this comparative research: Lytag (sintering process); Aardelite (hydrothermal process); Niro Atomizer ('cold' bonding process). The relevant properties of the three artifical aggregates and of the natural river gravel as an aggregate for concrete have been determined for the same particle size fraction. Concrete of the same quality and with the same workability has been produced for each type of the coarse aggregates investigated. Due to the spherical shape of Lytag and Aardelite the workability of these concrete mixes appeared to be better than that of concrete produced with natural river gravel (contains more flat grains) or Niro Atomizer (a crushed aggregate) under the same conditions. The strength of Lytag and Aardelite particles is smaller than for natural river gravel, which could be compensated by using a bit more cement. Other properties (expansion after submerging in water, drying shrinkage, creep) are also investigated.

9501 **(NF—2117) Sampling of fugitive coal dust. Subreport of the OWS-project 1.** ter Kuile, W.M. (Nijverheidsorganisatie TNO, Delft (Netherlands). Inst. voor Milieuhygiene en Gezondheidstechniek). Sep 1983. 112p. (In Dutch). Nijverheidsorganisatie TNO, Inst. voor Milieuhygiene en Gezondheidstechniek, Delft, Netherlands.

A review and evaluation of the principal sampling techniques for concentration measurements of fugitive coal dust is given. The sampling instruments under evaluation in the 'fugitive-dust'- programme, cover all groups of dust sampling techniques suitable for either determination of dispersion of (fugitive) coal dust in a short distance of the source or health related sampling of particle size fractions of the coal dust. Since the development of new dust samplers is current this review is limited to the most relevant dust samplers at the moment. Though it is expected that high wind-speeds (hard to stormy wind) will cause most annoyance by fugitive coal dust, probably representative dust concentration measurements are not possible under these circumstances with commercialy available dust sampling instruments. Based on frequency distributions of the wind-speed at places near the border of the Netherlands it is recommended to test the sampling efficiency of fugitive coal dust samplers for wind-speeds up to 12 m/s at 1.5 m above ground level. However, for wind velocities greater than 10 m/s reference instruments for sampling coarse dust will have to be developed.

9502 **(TNO-HMT—83-09557) Application of AFBC-coal ashes in cement, asphalt filler and artifical gravel.** Boesmans, B.; Gerritsen, R. (Nijverheidsorganisatie TNO, Apeldoorn (Netherlands). Hoofdgroep Maatschappelijke Technologie). Aug 1983. 32p. (In Dutch). Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Apeldoorn, Netherlands.

A pilot investigation is made of the possibilities to apply coal ash from an atmospheric fluid-bed combustor (AFBC) in cements, asphalt fillers and artificial gravel. Prospects for cement seemed promising, but the investigations in this field were limited to some complementary analyses and the evaluation of technical and economical possibilities. Concerning the asphalt filler, possibilities in this field are limited by the small market, for the demand for these filler materials we well as for the supply of AFBC-ashes. These factors give this product only a poor market value for asphalt filler. Investigations of the use as starting material for artificial gravel showed that relatively small amounts of AFBC-ash can yield good quality of gravel, which could easily replace the natural gravel used in concretes.

9503 **(TVA/OP/EDT—84/9) Economic evaluation of a sodium/limestone double-alkali FGD process.** Stephenson, C.D.; Burnett, T.A.; Torstrick, R.L. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Energy Demonstrations and Technology). Oct 1984. 89p. (EPA—600/7-84-096). NTIS, PC A05/MF A01. File Number DE85900875.

The report fives results of a comparison of results from a recent forced-oxidation limestone flue gas desulfuriation (FGD) process evaluation and those from a conceptual design and economic evaluation of a sodium/limestone double-alkali FGD process, based on recent EPA-sponsored pilot-plant and prototype test work. For a 500-MW new power unit burning 3.5% sulfur coal and meeting the 1979 new source performance standards, the estimated capital investments in 1982 costs are $95 million ($190/kW) for the sodium/limestone double-alkali process and $103 million ($206/kW) for the forced-oxidation limestone process. Estimated first-year annual revenue requirements in 1984 costs for these processes are $26 million and $29 million (9.3 and 10.6 mills/kWh), respectively. Although the sodium/limestone double-alkali process appears to be about 8% lower in capital investment, given the accuracy associated with studies of this type (+ or -10%), it is uncertain if the sodium/limestone double-alkali process has a lower capital investment. In terms of first-year and levelized annual revenue requirements, the sodium/limestone double-alkali process shows a 12% and 14% lower cost, respectively, than the forced-oxidation limestone process and (thus) is marginally less expensive. However, economics for the double-alkali process are more uncertain than those for the other.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 0109009446, 9448, 9480, 9481, 9554, 10377

9504 (BNL—35460) Health and environmental effects of coal-fired electric power plants. Morris, S.C.; Hamilton, L.D. (Brookhaven National Lab., Upton, NY (USA)). May 1984. Contract AC02-76CH00016. 44p. (CONF-8405235—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE85004043.

From International congress on the prospects and problems of coal-fired power plants; Brindisi, Italy (10 May 1984).

This paper describes health and environmental impacts of coal-fired electric power plants. Effects on man, agriculture, and natural ecosystems are considered. These effects may result from direct impacts or exposures via air, water, and food chains. The paper is organized by geographical extent of effect. Occupational health impacts and local environmental effects such as noise and solid waste leachate are treated first. Then, regional effects of air pollution, including acid rain, are analyzed. Finally, potential global impacts are examined. Occupational health concerns considered include exposure to noise, dust, asbestos, mercury, and combustion products, and resulting injury and disease. Local effects considered include noise; air and water emissions of coal storage piles, solid waste operations, and cooling systems. Air pollution, once an acute local problem, is now a regional concern. Acute and chronic direct health effects are considered. Special attention is given to potential effects of radionuclides in coal and of acid rain. Finally, potential global impacts associated with carbon dioxide emissions are considered. 88 references, 9 tables.

9505 (BNL—35469) Extrapolation to health risk: use of comparative approaches. Chapter 14. Morris, S.C.; Barancik, J.I.; Fischer, H.; Hamilton, L.D.; Jones, S.; Moskowitz, P.D.; Nagy, J.; Rabinowitz, S.; Thode, H.C. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 20p. (CONF-821048—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004054.

From 5. Life Sciences symposium on synthetic fossil fuel technologies; Gatlinburg, TN, USA (24 Oct 1982).

A method for risk analysis of complex technologies has been demonstrated, carrying the analysis from source term to increased cancer. The results provide a basis for comparing effects from various pathways and considering absolute magnitude of the risk from a synfuels plant. Other synfuels plants may not have the same emission rates, and these conclusions refer only to the specific plant analyzed. Comparison with others can be made on the basis of relative emissions rates. Effects from air emissions seem greater in Table V since air emissions are 50-fold greater than water emissions; on a unit-emission basis, upper-bound cancer estimates of Table V associated with water emissions are about 12 times greater than those associated with air emissions. It is not known whether the plant will produce any increase in cancer. This method of analysis produces a nonzero upper bound in any case in which the RAC includes a known or suspected carcinogen. We believe the upper bounds of the ranges are reasonably estimated. Although not exactly comparable, the highest upper-bound estimate is from local direct inhalation - 0.6% increase in cancer rate. This may be sufficiently high to warrant further consideration. The range of uncertainty is large, including zero. Although some aspects of uncertainty can be reduced by using more sophisticated models and better data, the uncertainty largely reflects the current state of knowledge and can be improved significantly only through better understanding of the mechanisms of chemical carcinogenesis. Risk analysis does not eliminate the problem of how to make decisions concerning new industries that emit pollutants which may cause cancer. It cannot produce better estimates than the data on which it is based. It simply provides a means of bringing existing knowledge to bear on problems in a systematic and useful way. 10 references, 5 figures, 7 tables.

9506 (KEMA—8139-83-MO-L) Investigation into the emission of air pollutants by the coal fired units 51 and 81 of the Amer power plant during the 12th week of 1983. Janssen, L.H.J.M.; Meij, R.; van der Sluys, J.L.G. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). Feb 1984. 65p. (In Dutch). Keuring van Elektrotechnische Materialen N.V., Arnhem, Netherlands.

The emission of following components in the stackgases of two coal fired units of the Amer power plant was measured and analyzed during the week from 21 to 25 March 1983: nitrogen oxides, sulfur dioxide, carbon dioxide, carbon monoxide, oxygen, hydrocarbons, hydrochloride, hydrofluoride, dust, heavy metal compounds and fly ash, of which the particle size distribution was also determined. Sampling and measuring methods are described and discussed.

9507 (NG—1251) Literature study of the emission of trace amounts by coal fired power stations. Veldt, C.; Huygen, C.; van Jaarsveldt, J.A.; Onderdelinden, D. (Nijverheidsorganisatie TNO, Delft (Netherlands). Inst. voor Milieuhygiene en Gezondheidstechniek). Mar 1983. 35p. (In Dutch). Nijverheidsorganisatie TNO, Inst. voor Milieuhygiene en Gezondheidstechniek, Delft, Netherlands.

Presented is a literature study of the concentrations of trace amounts (organic as well as inorganic) in coal fired power plants. Special attention is paid to following compounds: (a) Trace elements, (b) polycyclic hydrocarbons and (c) further organic compounds. Reasonable estimates of the emission of trace elements are possible with the help of coal composition and the efficiency of ash filters. Estimates of organic emissions are much more difficult. Figures found in literature are few and not reliable. Contribution to mean concentrations on ground level can be calculated with dispersion models, but due to many uncertainties the results of these calculations are only indicative.

9508 (ORNL/TM—8591) Synthetic fuel oil effects on microbial activity and nitrogen transformations in soil. Ward, M.H.; Saylor, G.S.; Luxmoore, R.J. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 81p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85004947.

Thesis. Submitted by M.H. Ward to the Univ. of Tennessee, Knoxville; Environmental Sciences Division Publication No. 2242.

The effects of a solvent refined coal oil (SRC-II) on microbial processes in a Captina silt loam soil were examined. The soil samples were maintained under environmental conditions favorable for most aerobic microbial activities. Soil was treated with four oil concentrations ranging from 0.2 to 8.6% (wt/wt). Oxygen uptake rates, total viable cell counts, numbers of nitrifying bacteria, and inorganic nitrogen concentrations were monitored before oil addition and at regular intervals for three months thereafter. Organic carbon, total nitrogen, and soil pH were also measured before and after application of the oil. The SRC-II coal oil effected soil processes at all treatment levels. The lowest oil concentration (0.2%) decreased numbers of nitrifying bacteria while increasing total viable cell numbers and net nitrogen mineralization. The higher oil concentrations reduced oxygen uptake rates and total viable cells as well as nitrifier numbers. Soil treated with a 1.7% oil concentration showed significant increases in respiration rates and cell densities after two months, while no significant increases were observed at oil levels of 3.4 and 8.6%. The application of the coal oil to soil samples raised the carbon to nitrogen ratio of the soil. The sum of nitrate and ammonium nitrogen in the oil-treated soils was never significantly lower than the control soil levels, indicating that nitrogen was not limiting to decomposition. However, the toxicity of the oil toward the nitrifying bacteria resulted in an accumulation of ammonium in treated soils. This may affect plant establishment on soils contaminated with a synthetic fuel oil. 104 references, 7 figures, 15 tables.

9509 **(PML—1984-IN-008) Choice of a tracer for the determination of the concentration of some metals in aerosols.** Oeseburg, F.; Vos, M. (Nijverheidsorganisatie TNO, Rijswijk (Netherlands). Prins Maurits Lab.). Mar 1984. 16p. (In Dutch). Nijverheidsorganisatie TNO, Prins Maurits Laboratorium, Rijswijk, Netherlands.

To investigate the pollution caused by smoke stacks it is necessary to add uncommon, extraneous and yet easily detectable compounds to the stackgases as a tracer. Air samples are taken and filtered with filter paper (Whatman 41). Judging from the results the compound strontium nitrate is recommended as tracer compound for stackgases.

9510 **(RISO-M—2420) Characterization of polycyclic organic matter (POM) from coal-fired power plants in the atmosphere and investigation of their transformation in the atmosphere.** Nielsen, T. (Risoe National Lab., Roskilde (Denmark)). Mar 1984. 113p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750119.

EFP-81.

This work describes investigation of the presence of polycyclic aromatic hydrocarbons (PAH), nitro-PAH and basic azaarenes in the atmosphere, evaluation of the importance of different sources (especially coal-fired power plants) for the presence of PAH in the atmosphere, and clarification of the atmospheric chemistry of PAH, especially their reaction with nitrogen dioxide/dinitrogentetroxide and nitric acid.

0110 Reserves And Exploration

9511 **(DOE/FE/05111—1681) Peat resource definition and utilization in Massachusetts. Final report, Phase One.** Brenninkmeyer, B.M.; Russo, J.S. (Massachusetts Executive Office of Energy Resources, Boston (USA); USDOE, Washington, DC). Oct 1984. Contract FG18-81FE05111. 189p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85004810.

To data less than five percent of Massachusetts peatlands have been developed. Ninety percent of the developed peatlands are located in the southeastern section of Massachusetts. Seventy-five percent of the developed peatlands are used for cranberry bogs. The remainder is used for horticultural peak extraction. At the present time peatland uses can be grouped into two types, consumptive and nonconsumptive. The primary consumptive uses are: (1) extraction of peat for use as or with industrial chemicals, (2) use by the horticultural industry and (3) most important under the DOE/MEOER Program, the use of peak as a fuel. The three uses of peat under consumptive usage will require extraction or harvesting of peatlands. The main nonconsumptive uses are: (1) preservation of peatlands for conservation lands, (2) biomass production, (3) timber production and (4) the most important under the title of nonconsumptive uses is peatlands for agricultural crop production. These four uses require little or no peat extraction, harvesting or alteration of the wetlands. The selection and feasibility of one particular use over another is influenced by the significance of the economics and environmental concerns as well as the types and volumes of peat. 55 figures, 12 tables.

9512 **(DOE/R4/10333—T3) US Department of Energy Region IV Unconventional Gas Program: summary and analysis.** Telle, W.R.; Thompson, D.A. (Alabama Univ., University (USA). School of Mines and Energy Development). Dec 1984. Contract FG44-80R410333. 148p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85004003.

The DOE Region IV Unconventional Gas Program involved the evaluation of unconventional gas resources at ten sites in the coal fields of the Eastern US. These projects dealt mainly with coalbed methane resources, although three of them also examined potential gas resources in Devonian black shales. The resource evaluations were accomplished primarily through recovery of core samples of potential gas-bearing strata and determination of specific gas content using the US Bureau of Mines direct method. In some cases actual gas production from the test holes was evaluated. Four of the projects were sited in the Warrior Basin, three in the Central Appalachian Basin, and one each in the Northern Appalachian Basin, the Deep River Basin of North Carolina, and the Valley Coal Fields of Virginia. Results from three of the projects, two in the Warrior Basin and one in the Northern Appalachian Basin, indicated the potential for economic recovery of coalbed methane. The projects included in this program provided a large body of data which is valuable to subsequent unconventional gas research. The program also provides new direction for unconventional gas exploration. Adjustments to coalbed methane resource estimates for some Eastern coal basins may be indicated by the results obtained. An update on the legal status of coalbed methane ownership in states where projects were conducted is provided in Appendix I. 5 references, 33 figures, 2 tables.

0120 Mining

REFER ALSO TO CITATION(S) 0120009551

9513 **(DOE/FE/00016—T65) [Longwall coal mining dust control]. Technical progress report, 1 November-30 November 1984.** (Foster-Miller Associates, Inc., Waltham, MA (USA)). 28 Dec 1984. Contract AI01-81FE00016. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005218.

During November, evaluation of the dust (and gas) concentrations around the tailgate drum zone continued with the spillplate extended up to the point of shield advance. The extension of the spillplate reduced recirculation downwind of the tailgate drum and also provided test conditions. In order to better evaluate the tailgate drum zone, additional sampling points were installed. Tracer gas concentrations from a twenty-one (21) point three-tier sampling volume arround the tailgate drum were measured for comparative purposes. Tests were conducted varying one test parameter at a time, normally under two spray conditions: (A) Base Line - drums rotating with drum sprays operating at 100 psi water pressure; and (B) Base Line (as in A above) - with a shearer clearer spray system at 150 psi water pressure. The tracer gas concentration at the headgate operator, tailgate operator and at the twenty-one point tailgate drum volume for each parameter change is presented in Table 1.

9514 **(SVEBIO—1983-1) PEAT 1982.** (Svebio Svenska Bioenergiforeningen, Stockholm). Jun 1983. 30p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750167.

The production of peat fuel in 1982 is presented together with plans for 1983 and 1984. 15 producers have produced 31800 m^3 sod peat and 152000 m^3 milled peat, corresponding to 35 GWh and 122 GWh, respectively. The production area for sod peat was 135 ha and for milled peat 340 ha. The preparation of ground was started in 1982/83 by 29 producers over 3700 ha for sod peat, over 800 ha for milled peat and covering 200 ha for deep mining.

9515 **(TORV—84-2) Small scale production of peat for fuel. State-of-the-art and future development.** Geijer, S.; Thunander, H.; Hagstroem, K.; Falkestroem, L. (Sveriges Lantbruksuniversitet, Garpenberg. Forskningsgruppen foer Smaaskaligt Skogsbruk). Dec 1983. 136p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. File Number DE85750166.

The object of this investigation has been to estimate the possibilities for developing methods of peat production on a small scale basis. The harvesting techniques used today are very weather dependent. This calls for a flexible labour force, which is often more suitable for small scale production. Peat production in combination with other activities has been studied. Peat production combined with forestry has proved to be the most advantageous combination. Even distribution of work throughout the year and utilization of the same base machine in both areas is then possible. The choice of base machine is crucial both for production and economy. A specification of the performance that should be demanded from such a vehicle is given in the report. Small scale peat production techniques are not yet fully developed. Reliability and capacity of the machines used is not satisfactory. A systems analysis on peat production has been made. It shows the influences of various factors on the production. The weather dependency and area requirement have also been analysed in attempts to find new production techniques. The results from the analyses of small scale peat production suggest new production systems. Some of the suggested production

methods which are available on demonstration scale only, are discussed in the report.e both production and the quality of the end product. Some possible storage methods are presented.

9516 **(HSE-Trans—10014) Investigation of the composition of the gases and coal residues after the explosion of Oligocene coals.** Vukanovic, B. (Health and Safety Executive, London (UK); Rudarski Inst., Belgrade (Yugoslavia)). Oct 1981. Translation source information not available . (CONF-8110246—3). 9p. NTIS (US Sales Only), PC A02. File Number DE85900532.

From 19. international conference of research institutes in safety in mines; Katowice, Poland (5 Oct 1981).

Tests on dust prepared from coal from the Zenica and Breza mines were carried out in a 40 litre explosion chamber, with a 5 kJ igniter. The tests carried out on the coal dust residues after explosion in the explosion chamber reveal the changes that have occurred: (1) After a methane explosion in a mine one can, by the change in the composition of the coal dust, decide whether the dust has played a part in the explosion or not. (2) The gases occurring after the coal dust explosion usually contain carbon monoxide, hydrogen, carbon dioxide and methane. (3) This composition is toxic and combustible. Comparisons were carried out with the lower explosion limit obtained by calculating the stoichiometric concentration in the laboratory. 6 references, 2 figures, 2 tables.

9517 **(HSE-Trans—10013) Problems of mechanical sparks in USA coal mines.** Courtney, W.G.; Saltzmann, R.; Mundell, L.; Abgede, R. (Health and Safety Executive, London (UK); Westfaelische Berggewerkschaftskasse, Bochum (Germany, F.R.). Inst. fuer Maschinentechnik). Oct 1981. Translation source information not available . 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900527.

The results of the investigations carried out in USA can, essentially, be confirmed by our results. According to the USA report, however, the various tests give only a qualitative verdict has ignited or has not ignited. In order to get a quantitative result we have developed a measuring procedure. We based our considerations on the fact that, for an ignition, in addition to ignitable CH_4/air mixture and potential initiator (for example, quartz-containing or pyrite-containing rock), three parameters are necessary: (1) the temperature of the spark or hot particle must be higher than the ignition temperature of the mixture, (2) its energy content must be so great that the amount of energy necessary for heating and ignition can be transferred to a sufficiently large volume of the mixture, and (3) the duration of action of this quantity of energy, at a sufficiently high temperature, must be long enough for ignition to occur. In order to be able to take account of and to record these three values, a computer-aided non-contact temperature-measuring process was developed. The Institut fuer Maschinentechnik der Westfaelischen Berggewerkschaftskasse is carrying out these tests as part of the research project reducing the ignition hazard. These tests deal with cooling measures for the cutting track and for the picks used in working the rock surrounding coal seams, when methane/air mixtures are present. This project is subsidized by the Minister for Economic Affairs of the State of North Rhine/Westphalia. A series of ignitions have occurred caused by coal-cutting operations during heading and coal-cutting, because ventilation measures alone cannot quite exclude the occurrence of accumulations of flammable gas.

9518 **(HSE-Trans—10009) Recent investigations on the influence of particle size in coal dust explosions.** Reeh, D. (Health and Safety Executive, London (UK)). Jun 1981. Translation source information not available . (CONF-8110246—1). 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900526.

From 19. international conference of research institutes in safety in mines; Katowice, Poland (5 Oct 1981).

A suitable experimental technique was developed and small-scale tests were carried out, demonstrating that the explosion violence of coal dusts increases with increasing fineness of the dust. There is no optimum particle diameter, such as was found in earlier investigations. Large-scale tests confirm these results. A limiting particle diameter, above which a coal dust explosion is no longer possible, cannot be defined without overmuch simplification. If fine dust is added, coarse-grained material can itself become explosive, even when the concentration of the fine dust is definitely below the lower explosion limit. 3 references, 8 figures, 3 tables.

9519 **(HSE-Trans—8472) Effective schemes for controlling gas-emission in coal-winning areas.** Yevseyerv, V.; Myasnikov, A. (Health and Safety Executive, London (UK)). Oct 1979. Translation source information not available . (CONF-7910234—1). 10p. NTIS (US Sales Only), PC A02. File Number DE85900534.

From 18. international conference on scientific research in the field of safety at work in mining industry; Dubrovnik, Yugoslavia (7 Oct 1979).

Extraction of coal without leaving pillars is particularly effective in preventing gassing in the T-junctions of extraction faces with ventilation drifts, i.e. it makes it possible to disperse the gas output from the goaf of the active longwall over a considerable length of the ventilation drift behind the face of the longwall. In order to widen the range of application of these schemes it is necessary to achieve the extraction of gas from the goafs through holes of large diameter bored from the surface in which large-head suction fans are installed or through holes of small diameter with vacuum-pumps installed in them. Thus, the most reliable and effective measures in the fight against gas at junctions of excavated workings and ventilation drifts is the introduction of special drainage workings, making it possible not only to eliminate localized accumulations but also to drain and move all the gas from the goaf and part of the face area directly into the outgoing flow of the sector, district or mine. In order to increase the efficiency of drainage drifts, an individual outlet of the methane-air mixture from the drainage drift is used with the help of a centrifugal fan through a pit or hole of large diameter (500 to 600 m) bored from the surface. Therefore, in the application of the described method of control of methane-emission, the need to apply other methods and, particularly, degassing methods loses it significance. The greater the amount of the methane-emission from the goaf, then the greater is the scope for a drainage working to increase the face output. Based on test work on the degassing of adjacent seams, the most effective and sensible method is considered to be the boring of degassing holes from drainage drifts and other adjacent workings, driven through the rock, adjacent or development seams. With such a degassing scheme, a degassing efficiency of adjacent seams of up to 60 ~ 80% is achieved.

9520 **(HSE-Trans—8469) Yield of gas in lignite mines in relation to the conditions in the mine.** Teply, E. (Health and Safety Executive, London (UK); Rudarski Inst., Belgrade (Yugoslavia)). Oct 1979. Translation source information not available . (CONF-7910234—2). 15p. NTIS (US Sales Only), PC A02. File Number DE85900536.

From 18. international conference on scientific research in the field of safety at work in mining industry; Dubrovnik, Yugoslavia (7 Oct 1979).

In the Velenje lignite mine the gas content increases with the depth. The quantity of ventilation and the % age gas content in the ventilation are related by a hyperbolic function. Consequently there exists an optimal quantity of ventilation suited to the mining conditions with which it is possible to achieve only a limited reduction in gas content. In addition to the ventilation, one must try to apply other measures for reducing the gas in the mine. The % age CO_2 content in the Velenje lignite mine, which amounts to 0.9 to 1.4%, indicates a requirement for a higher % age CO_2 content to be approved for regular work in the mine.

9521 **(HSE-Trans—8460) Energy spread of free gas in oligomiocenic coal fields and its outburst capacity.** Jovanovic, G.; Jovicic, V. (Health and Safety Executive, London (UK)). Sep 1979. Translation source information not available . (CONF-7910234—3). 12p. NTIS (US Sales Only), PC A02. File Number DE85900544.

From 18. international conference on scientific research in the field of safety at work in mining industry; Dubrovnik, Yugoslavia (7 Oct 1979).

Rock bursts have occurred in brown coal mines in Yugoslavia and have caused several fatalities. In one of these cases it is calculated that the amount and potential energy of the free gas in

the coal (or sandstone) at the pressure of 17 kp/cm² was sufficient to discharge the amount of coal and gas that occurred. This free gas is apparently mainly at disturbed and fault areas of the seam. Based mainly on this idea and pressure measurement, areas prone to rock burst are identified. 6 references, 5 figures. (LTN)

9522 **(HSE-Trans—7262) Model of the criteria for evaluation of the danger of spontaneous ignition of coal at the working face.** Matusek, Z. (Health and Safety Executive, London (UK)). Sep 1977. Translation source information not available . (CONF-7710198—12-Trans.). 9p. NTIS (US Sales Only), PC A02. File Number DE85900540.

From 17. international conference of mining safety research; Varna, Bulgaria (3 Oct 1977).

To evaluate the danger of spontaneous ignition of coal during the extraction of seams, and to determine the most effective fire-prevention measures, a decisive factor is the connection between the aerodynamics of the working face and the danger of initiation of the process of spontaneous ignition. Non-isolated old mine workings are always connected to the ventilation network of the mine, and thus it is impossible to consider aerodynamic phenomena at the working face separately, i.e. with regard to their open profile, but is necessary to consider the whole aerodynamic system of the working face - the caving zones. Resolution of the aerodynamic phenomena in the caving zone is made difficult by the fact that it is impossible to measure the required values directly. Therefore we must proceed from values taken in open spaces, i.e. at the longwall and in adjoining galleries. However, determination of these initial values is insufficient for a mathematical expression of the corresponding aerodynamic phenomena in the caving zone, and for their successful resolution. In accordance with the results of laboratory experiments and long term statistical research into the analysis of the reasons for spontaneous ignition, a Model of the criteria for evaluation of the danger of spontaneous ignition at the working face was evolved. This model summarizes the results of careful research applying ball (wind force) values, and conclusions were drawn from: (1) experiments with models with equivalent materials; (2) experiments with models of the mutual relationship of the working face and the caving zone using the analogue method; and (3) statistical analysis of the reasons for the initiation of spontaneous ignition at the working face. The model may be used to plan mine workings and to choose the optimum method of fire prevention.

9523 **(SMRE-Trans—7257) Research into the dynamics of methane pressure in underlying and overlying coal seams with sudden outburst hazard when artificial degasification is used.** Ayruni, A.T. (Health and Safety Executive, London (UK)). Sep 1977. Translation source information not available . (CONF-7710198—8-Trans.). 14p. NTIS (US Sales Only), PC A02. File Number DE85900548.

From 17. international conference of mining safety research; Varna, Bulgaria (3 Oct 1977).

The tests of the degree of gas depletion and the dynamics of the decrease in methane pressure in the protected seams with applied artificial degassing through rifts were performed with the aid of 236 experimental rifts of a total length of over 34,000 m. The maximum depth of the inter-seam thickness was 190 m with underworking and around 100 m with over-working. The limits of the variety of natural and mine-engineering conditions were: depth from 200 to 950 m, the angle of deposit from 2° to 70°, extractive capacity of protective seams from 0.5 to 2.5 m, discharge of volatile substances from 7 to 42% and length of longwall from 100 to 230 m. The degree of degassing of protected seams degassed through rifts was compared with the degassing in conditions where artificial degassing of protected seams was not carried out. The tests established that with small radii of degassing of protected seams, the introduction of additional exit routes for the methane from them, in the form of degassing rifts, has practically no effect on lowering the methane pressure in the protected seam (on the level of degassing it). The role of degassing rift-channels increases in proportion to the increase in the depth of the inter-seam thickness and, consequently, to the rise in the resistance of the inter-seam thickness, broken by fissures, to the movement of gas. It was established by analysis and generalization of the experimental results and data, and by comparing them with previously proposed data, that degassing of underlying and overlying coal seams by rifts increases the degree of degassing of protected seams or (at an accepted equal gas pressure) increases the radius of the protective effect. The coefficient of the degree of degassing of protected seams depends on the depth and magnitude of resistance of the inter-seam thickness to the movement of gas, and in artificially degassed seams significantly increases. 15 references, 5 figures, 2 tables.

9524 **(SMRE-Trans—7259) Factors involved in the hazard of firedamp and coal dust explosions in the case of rockbursts.** Matuszewski, J. (Health and Safety Executive, London (UK)). Sep 1977. Translation source information not available . (CONF-7710198—7-Trans.). 12p. NTIS (US Sales Only), PC A02. File Number DE85900545.

From 17. international conference of mining safety research; Varna, Bulgaria (3 Oct 1977).

From this paper, the following conclusions may be drawn: (1) The foregoing considerations and the described example demonstrate the existence of the considerable risk of firedamp - and coal dust explosions following rockbursts. The described explosion, which happened at the Anna Mine, was the first explosion of this kind to be recorded and investigated. (2) The considerable increase in the explosion hazard as a result of rockburst is caused by the following factors: the formation of explosive methane concentrations in the mine workings, the creation of road sections that are not protected against coal dust explosions, and the occurrence of factors initiating CH_4 - and coal dust explosions. (3) Although the CH_4 - and coal dust explosion hazard due to rockbursts occurs mainly in gassy seams, one cannot exclude the risk of coal dust explosion following rockburst even in non-gassy seams, where the explosion may be initiated by an electric arc following a short circuit caused by damage to electric apparatus, cables and leads especially in the case of high tension equipment. (4) When working in seams endangered by rockbursts, it is necessary to take certain precautions and, in the case of a rockburst in a gassy seam, to undertake the appropriate rescue measures.

9525 **(HSE-Trans—7263) Recent trends in preventive fire protection for underground mining.** Florschutz, P.; Haisler, K. (Health and Safety Executive, London (UK)). Sep 1977. Translation source information not available . (CONF-7710198—11-Trans.). 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900541.

From 17. international conference of mining safety research; Varna, Bulgaria (3 Oct 1977).

The need to use combustible work materials and process materials to an increasing extent, in underground mining also, necessitates further development of measures for preventive fire protection. Starting out from investigations into the combustibility of materials, the possibilities for fire detection and for fire-fighting, it becomes necessary to assess, on the basis of prescribed rules, the fire hazard which exists in the mine in question, the aim being to keep the fire risk small. Taking account of this, a draft Standard for fire protection underground was drawn up by the Institute for Mining Safety, in close collaboration with the Mines Inspectorate and the individual mines. This Standard takes into consideration the specific fire characteristics of the materials which are to be used, their ignition behaviour and behaviour in fire, thermal decomposition products (smoke and toxic gases) and also the possible sources of ignition at the place of utilization and the existing requirements for the spread of fire. The possible effects of a fire should be assessed on the basis of danger to persons and/or material goods. Taking note of all these moments of danger, classification into one of five fire hazard grades is made. From the hazard grade which is determined, appropriate measures can then be deduced. These can vary enormously and include fire detection and fire-fighting, as well as technical and organizational measures. The aim of the Standard is, firstly, to systematically detect and eliminate fire hazards in mines, and secondly, not to hinder the progress made through the use of new materials.

9526 **(HSE-Trans—7261) Possible methods of estimating the temperature at the site of a fire from changes in the composition of the air.** Muzyczuk, J. (Health and Safety Executive, London (UK)). Sep 1977. Translation source information not available . (CONF-7710198—10-Trans.). 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900543.

From 17. international conference of mining safety research; Varna, Bulgaria (3 Oct 1977).

Recognition of the actual danger of underground fires is very important for the economic working of coal seams. One of the quantitative criteria of this danger would be the temperature of the possible site of a smouldering fire, the direct detection of which constitutes a very difficult problem. It is possible to estimate this temperature by an indirect method and very encouraging results have been obtained from research on the spontaneous heating of coals. It is a question of the correlation between the Graham index and the temperature of the seat of the fire, expressed by the regression equations 1 to 4, and also the proposed method of determining the Graham index characteristics of the coal oxidation phenomena proceeding in the zone of origin of the fire itself. The formulae are sufficiently complex that reference should be made to the report. (LTN)

9527 **(HSE-Trans—7256) Initial rate of gas emission from coal as one of the indices of outburst hazards in coal seams.** Lidin, G.D.; Ettinger, I.L. (Health and Safety Executive, London (UK); AN SSSR, Moscow. Inst. Fiziki Zemli). Sep 1977. Translation source information not available . (CONF-7710198—9-Trans.). 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900524.

From 17. international conference of mining safety research; Varna, Bulgaria (3 Oct 1977).

Comminution of coal also has another feature that promotes sudden outbursts of coal and gas. Before the gas is emitted from the coal and becomes capable of performing work, it must expend a part of its potential energy on migration inside the coal fragment to an outlet on the surface. It follows that the initial intensity of gas emission from the coal fragments and the force generated by the expanding gas depend on the degree of comminution of the coal and on the resulting total surface of coal giving off gas; secondly, this itself affects the amount of energy that may be utilized for the sudden outburst. In addition to this, the intensity of the initial gas emission is determined by the pressure drop of the gas (inside and outside the coal fragments), the natural gas content of the coal, the gas permeability of its substance, the viscosity of the gas, and the temperature of the process. It follows that determination of the force that may be generated by the gas in the initial moment of a sudden outburst of coal and gas is a complex problem that still awaits solution, but it is evident that the force is determined by the complex aggregate of factors indicated, the parameters of which are mutually interdependent. As it is not at present theoretically possible quantitatively to include all the inter-relationships, it is necessary in practice to use empirically established inter-relationships. In order to simplify matters and to be able to obtain quickly the results of a determination of the gas-output capability of coal, an express method has been developed for detecting coals with an outburst-prone structure, and also for determining the characteristics of coals, separated from the massif as a result of dynamic phenomena. The latter is for the diagnosis of sudden outbursts, which is important for the investigation of mine disasters.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 0130009483, 9485, 9515, 9547

9528 **(BCRNL-L—1447) Evaluation of the effect of coal cleaning on fugitive elements. Phase IV. Identification of mineral forms in coal. Quarterly progress report No. 6, September 1, 1984-November 30, 1984.** Streeter, R.C. (Bituminous Coal Research, Inc., Monroeville, PA (USA). National Lab.). 2 Jan 1985. Contract AC22-83PC62690. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004183.

Coal samples were received during this report period from the Otisca T and LICADO processes. Otisca A (high-ash) feed and product coals were analyzed for mineral forms by x-ray diffraction; a significant reduction of α-quartz in the product coal was observed. Preliminary trace element data on the Otisca B (low-ash) samples show higher-than-average amounts of cobalt and lower-than-average amounts of copper, lead, nickel, and zinc in both the feed and product coals, compared with data for other eastern US bituminous coals. In particular, the lead concentrations in the Otisca B samples are much lower than average. 1 figure, 4 tables.

9529 **(CONF-8409193—1) Design characteristics of the hydrocyclone for the recovery of coal fines.** Davis, P.K.; Clendenin, H.B.; Peter, M.M. (Southern Illinois Univ., Carbondale (USA). Dept. of Engineering Mechanics and Materials). 1984. Contract FG22-81PC40807. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005066.

From 2. international conference on hydrocyclones; Bath, UK (19 Sep 1984).

The relevant design parameters and flow variables of the standard hydrocyclone have been identified. Two experimental systems have been designed and constructed so that the flow rate, inlet area, vortex finder length and diameter, underflow diameter, length of hydrocyclone chamber and cone angle can all be varied, one at a time, while all the other variables are held constant. Dimensional analysis was used to guide the experiments. Initially spheres were used to model solid particles. Data has been taken using spheres ranging in size from 0.03175 m to 0.09525 m with specific gravities varying from 1.05 to 2.10. This range of specific gravities was chosen so as to contain the specific gravity range of coal which varies from 1.2 to 1.6. The specific gravities of the waste materials in gob (clay, shale, pyrite and sandstone) are greater than 2.00. It was later shown that the data taken using spheres compare well with random shaped coal particles with approximately the same mean diameters as the spheres. The sphere data can be used to select a hydrocyclone configuration to perform a specific separation task. In this research, the sphere data was used as a guide to select a configuration to separate coal fines from gob material. Good coal fines recovery from gob samples has been achieved on a batch basis. An an example, Table 1 gives data from one sample showing a combined recovery of 99% by weight with a product rating of 0.95. Another significant finding in this research is that dynamic similitude as predicted by dimensional analysis can be verified using the two experimental systems with hydrocyclones with different diameters. Thus the data taken can be used to scale up or down as the need arises. 10 references, 13 figures, 1 table.

9530 **(DOE/ET/15465—1298) Coal flow meter development. Phase A: feasibility study.** King, J.D.; Hornung, P.A.; Rollwitz, W.L. (Southwest Research Inst., San Antonio, TX (USA)). Apr 1980. Contract AC21-79ET15465. 89p. NTIS, PC A05/MF A01. File Number DE83006413.

The analysis of the coals performed from both NMR and ESR data revealed several interesting results. First, adequate signal levels for flow metering can be obtained from all coals with either the hydrogen nuclear magnetic resonance or the electron spin resonance. However, the higher signal/noise ratio of ESR makes it more advantageous than the NMR for use in measuring the flow rate, although either or both could be used. Second, the ESR amplitude is highly correlated with the amount of carbon in the coal and with the ratio of the carbon to volatiles. Third, hydrogen NMR can be used to separately measure both the volatiles and the water content of the coal. In summary, the conceptual design of the flowmeter is as originally proposed based on the use of a spin filter oscillator, which derives ESR signals from the free radicals in coal. The results of the ESR and NMR measurements and information from the literature as well as on the prior experience of SwRI in the development of applied magnetic resonance devices confirmed the basic feasibility of this approach. These signals were found to be of useful intensity throughout the entire set of domestic coals. In the proposed configuration, the flowmeter will measure the flow velocity by sensing the frequency shift in the spin filter oscillator. The concentration of the coal (and the carbon) in the flow stream will be sensed as a function of the ESR amplitude. NMR techniques will be used to simultaneously measure the moisture and volatiles contents of the coal. The heating value of the coal will be estimated by use of both ESR and NMR measurements.

9531 (DOE/FC/QTR—82/4-83/1) [Low-rank coals research]. Quarterly technical progress report, July-December 1982. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Sep 1984. 238p. NTIS, PC A11/MF A01; GPO Dep. File Number DE85004811.

Research on low rank coals is reported as follows: removal of sodium by ion exchange; hot water drying (under pressure) of low rank coal; liquefaction of low rank coal; slagging fixed bed gasification; atmospheric fluidized-bed combustion; fouling of boiler by ashes; simultaneous removal of sulfur oxides and nitrogen oxides from flue gas power plant emission control. Waste disposal of sludges; trace element studies; synthesis of model compounds; ash and slag characterization. (LTN)

9532 (DOE/PC/42302—2-Vol.1) Fundamental study for improvement of dewatering of fine coal/refuse. Annual report, July 1981-July 1982. Volume I. Chiang, S.H.; Klinzing, G.E.; Tierney, J.W.; Bayles, G.; Gala, H.; Kakwani, R.; Pien, H.L.; Rega, R.; Yetis, U. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Aug 1982. Contract AC22-81PC42302. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85005085.

The overall objective of the study is to seek improved methods of dewatering through a better understanding of the filtration and post-filtration processes. As a first step, efforts have been focused on the mechanism of dewatering in terms of basic properties of coal (and refuse) particles and filter cakes and their relations to filtration rate and final cake moisture content. This annual report presents the highlights and accomplishments of the third year of the project. The report is divided into four parts: summary and deliverables; work forecast for the fourth year; detailed description of technical progress; and appendices. Volume I contains the first 3 parts. Progress reports are presented for the following tasks: (1) particle/filter cake characterization; (2) theoretical modelling; (3) experimental measurements of filtration and dewatering; and (4) enhanced dewatering method. 17 references.

9533 (DOE/PC/42302—2-Vol.2) Fundamental study for improvement of dewatering of fine coal/refuse. Annual report, July 1981-July 1982. Volume II. Chiang, S.H.; Klinzing, G.E.; Tierney, J.W.; Bayles, G.; Gala, H.; Kakwani, R.; Pien, H.L.; Rega, R.; Yetis, U. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Aug 1982. Contract AC22-81PC42302. 88p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85005086.

Volume II contains appendices for: (1) tables; (2) figures; (3) major assumptions, equations, and solution description for one phase permeability module; (4) calculation of bond entry diameter; and (5) computer programs for theoretical permeability module. 58 figures, 14 tables.

9534 (DOE/PC/42302—T1) Fundamental study for improvement of dewatering of fine coal/refuse. Semi-annual report, November 1981-April 1982. Chiang, S.H.; Klinzing, G.E.; Tierney, J.W.; Bayles, G.; Gala, H.; Kakwani, R.; Pien, H.L.; Rega, R.; Yetis, U. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). May 1982. Contract AC22-81PC42302. 53p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85005087.

The objectives of this research program are to formulate models for predicting the efficiency of mechanical dewatering, the rate of dewatering and the residual moisture content of dewatered coal/refuse and to suggest improved mechanical dewatering methods. To achieve these objectives, the following tasks are being carried out: (1) characterization of fine coal particles and filter cakes; (2) theoretical models for fine coal dewatering, (3) experimental measurement of dewatering; and (4) enhanced dewatering methods. Some highlights for this reporting period are: (1) important improvements in the micrographic analysis of coal filter cakes were achieved, (2) refinement of the model to predict the one-phase flow rate and permeability for the coal cake was initiated; (3) controlled filtration and dewatering experiments were carried out with different size fractions of the -32 mesh Pittsburgh seam-Bruceton mine coal; (4) filtration and dewatering experiments with five surfactants were completed; and (5) data analysis shows a strong correlation for the adsorption isotherm of all five surfactants with the reduction in moisture content. 6 references, 31 figures, 7 tables.

9535 (DOE/PC/42302—T2) Fundamental study for improvement of dewatering of fine coal/refuse. Annual report, August 1982-August 1983. Chiang, S.H.; Klinzing, G.E.; Morsi, B.J.; Tierney, J.W.; Adams, J.; Bhat, N.; Binkley, T.; Chi, S.M.; Kakwani, R.; Qamar, I. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Sep 1983. Contract AC22-81PC42302. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85000503.

The overall objective of the study is to seek improved methods of dewatering through a better understanding of the filtration and post-filtration processes. As a first step, efforts have been focused on the mechanism of dewatering in terms of basic properties of coal (and refuse) particles and microstructures of filter cakes, and their relations to filtration rate and final moisture content. Pittsburgh seam-Bruceton Mine coal was used as a base coal with experiments also being conducted with Upper Freeport and Illinois No. 6 coals. During the past year, filter cakes from the above coals with widely varied size ranges were micrographically characterized. The effects of a number of surface active agents and of entrapped air bubbles on the filter cake properties were also studied. A module of the network model for calculating single phase permeabilities was completed and tested. The report is divided into four parts: summary and deliverables; work forecast for the 1983-84; detailed descriptions of technical progress for particle/filter cake characterization; theoretical modeling, and enhanced dewatering methods; and appendices. 11 references, 35 figures, 11 tables.

9536 (DOE/PC/60773—T1) Feasibility study on liquid coal preparation and coal char demineralization. Technical progress report - 5, September-November 1984. Im, C.J.; McCown, F.E. (United Coal Co., Bristol, VA (USA)). 1984. Contract AC22-83PC60773. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005057.

The subject project is being conducted via the two phases shown below: (1) liquid coal feasibility study; and (2) demineralization of char. The United Coal Company (UCC) bench-scale pyrolysis system operated satisfactorily during the reporting period. It was run primarily to produce high quality coal liquids for the char/liquid blends. However, informative operating parameters were also gleaned from the tests. Blends using Battelle pyrolysis products were made with up to 45% char, however a 40% char loading in Battelle liquids represented the upper practical limit. Blends using UCC pyrolysis products were made with up to 60% char, but a 50% loading is probably the upper practical limit. Residual chlorine values were high (i.e., about 13 to 14%) in low temperature treated chars, and low (i.e., about 0.9%) in high temperature treated chars. For reference, chlorine ranged from 0.43 to 0.84% in the untreated Battelle liquids. Advanced Energy Dynamics advised that, using their six-inch electrostatic precipitator, no separation of ash from Battelle chars was achieved. Their report indicated that, in their opinion, the Battelle chars could not be significantly beneficiated via electrostatic methods. 1 table.

9537 (DOE/PC/62702—T1) Heavy-liquid-beneficiation of fine coal, Phase II. Final report. Simmons, F.J.; Keller, D.V. Jr. (OTISCA Industries Ltd., Syracuse, NY (USA)). Nov 1984. Contract AC22-83PC62702. 83p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85005232.

Heavy-Liquid-Beneficiation of Fine Coal is a two-phase multitask fundamental research program directed towards the development of a basic understanding of the rheology of fine-coal/heavy-liquid slurries and the application of this understanding to the development and operation of a heavy-liquid fine-coal benefication pilot test facility using cyclone technology. (HLC)

9538 (DOE/PC/63049—T1) Ultrasonically enhanced size reduction of coal: Phase II. Quarterly report No. 1, September 27-December 27, 1983. (Energy and Minerals Research Co., Exton, PA (USA)). Jan 1984. Contract AC22-83PC63049. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004150.

Phase II work is being carried out as necessary for developing ultrasonic enhancement of coal size reduction in order to establish the potential of improved energy efficiency via continuous operating at both lab and pilot plant scales. Emphasis is placed on col-

lecting in-depth information relating the process variables of ultrasonic power input, auger rotational speed, etc., and obtaining valid engineering scale-up data during continuous grinding operation. Selective grinding is evaluated by contrasting ultrasonic runs with non-ultrasonic controls by washability testing of the grinding products. According to the contract scope of work the tests shall be carried out with two clean coals having different hardness to establish the utility of the ultrasonic technique over a broad range of coal obtained from US mines. The contractor shall utilize the auger array, modified to allow continuous operation, to obtain engineering data for scale-up of the grinding array (product sizes of 100 mesh and below). An array shall be assembled to verify these scale-up parameters and shall have a capacity of up to 2000 lbs/hr for 80 percent -200 mesh product and 400 lbs/hr for 80 percent -20 micron product. A cost estimate of the capital, operating, and maintenance costs for ultrasonic grinding shall be prepared, based on the design parameters obtained. During this past quarter, work was focussed on the following three areas: (1) modification of the existing auger for continuous operation; (2) installation of the monitoring equipment; and (3) procurement of coal samples for the grinding tests. Each of these areas is discussed.

9539 (NU—1983-3) Common Nordic coal import. (Nordisk Ministerraad). 1983. 72p. (In Swedish). Nordisk Ministerraad. File Number TI85750189.

Summary in Swedish and in Finnish.

This is a joint Nordic report on the economics of transocean coal import to Scandinavia. In particular, possible advantages of coordinated import, e.g., reloading or partial unloading of large carriers for later distribution to harbors of limited capacity is studied. This is of special relevance for the Baltic harbors, i.e., Finland and the Swedish eastcoast. It is found that import of coal from Australia to the Baltic area is most economic using large carriers and making a partial unload in Denmark before entering the Baltic. For transport to small harbors in the Baltic, a reloading harbor in southwest Finland and one in southeast Sweden are best situated for servicing the northern and southern areas respectively. The report also presents statistics on coal import, consumption and transport in the Nordic area.

9540 (SVF—134) Spontaneous ignition of steam coal stockpiles. Zetterlund, B. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Apr 1983. 103p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750194.

Steam coal in bulk reacts with air oxygen at ambient temperatures. This increases the reaction velocity and spontaneous combustion may occur. The freshly mined coal immediately starts to react with oxygen. There is a fast physical adsorption of oxygen with an adsorption heat of roughly 20 kJ/mole O_2. At temperatures above ca 85 deg C hydrogen, ethylene and propylene are also produced. Reaction velocity at a constant temperature and a given grain size is proportional to oxygen partial pressure and inversely proportional to the square root of the total time of contact with air. The coal grain may be regarded as a semiporous body. The coal oxygen reaction follows Arrhenius' equation. The activation energy is in the range 50-100 kJ/mole. Coals differ in their behaviour in respect to spontaneous ignition. The main parameter is total surface or porosity. Moisture, high content of fine grains and freshly opened grain surfaces promote coal heating. Spontaneous heating in coal stockpiles are therefore best prevented if oxygen admission to the pile is slowed down or prevented through compaction of the heap in layers, or by covers. In open stacks grain size desegregation should be prevented as this facilitates the oxygen transport into the pile. Spontaneous ignition in stockpiles generally occurs some one to two meter below the surface in the pile top region.

9541 Measurement of particle and slip velocities in coal/gas system. Mathur, M.P.; Klinzing, G.E. (Pittsburgh Energy Technology Center, U.S. Department of Energy, Pittsburgh, Pennsylvania). *ACS Symposium Series;* **79**: No. 222, 60-65(1983).

The most evasive properties of solid/gas transport, particle, and slip velocities have been determined experimentally using an Auburn Monitor. A High Pressure (150 psig) Coal Flow Test Facility, in which two Auburn Monitors were installed in a vertical limb two feet apart, was used to conduct the coal flow tests. The signals from the two Auburn Monitors were cross-correlated using a commercial correlator. The time delay between the two signals was measured from the cross-correlation function, which in turn yielded the particle and slip velocities. Coal flow tests have been carried out at solid/gas loadings as high as 50 lb of coal/lb of gas. At certain loadings, slip velocities were quite large. The availability of particle and slip velocities permits more complete modeling analysis.

0140 Combustion

REFER ALSO TO CITATION(S) 0140009487, 9531, 9540

9542 (CONF-8404201—11) In-bed circulating fluidized bed. Manicke, A.C. (International Boiler Works Co., East Stroudsburg, PA (USA)). 1984. 16p. University of Kentucky, 112 Frazer Hall, Lexington, KY. File Number TI85900887.

From 23. annual Kentucky industrial coal conference; Lexington, KY, USA (11 Apr 1984).

Experience shows that fuel and bed material in a conventional vertically fluidized bed tends to mix within a maximum of a 6 to 10 square foot area. If the area is smaller, even better consistency is achieved. Thus, for each such increment of bed area, an additional feeder and ash extraction point are required. If not, the bed will not be homogenous or consistent, and operation problems will probably result. As a result of increased bed sizes for higher capacity, more fuel feed points and ash extraction points are required. This only compounds the problem since more feed points are harder to control and have a tendency to segregate the fuel feed too much. So rather than equal flow to all parts of the bed, one area may receive more fines or heavies than the others and again problems result. Above bed feeding systems aren't any better than inbed or below bed feed systems in a conventional horizontal bed. The application of conventional spreaders used with stokers causes severe problems of free board burning, bed temperature control and slagging, not to mention difficulty in maintaining minimum bed temperatures. The corrective action for the feed problems, ash problems and general control and operation problems, as previously described, is to provide inbed lateral mixing. With the in-bed mixing (circulation), AFBC problems of feeding and ash extraction are minimized since only one feeder and one extraction point are required. An attached paper by different authors has been entered individually into EDB and ERA. (LTN)

9543 (DOE/ET/10393—1623) Tube Bank C - metal wastage: status report, August 1983. (NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)). Jan 1984. Contract AI01-76ET10393. 450p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE84012018.

The Experimental Pressurised Fluidized Bed Combustion Facility at Grimethorpe, South Yorkshire, UK incorporates an in-bed tube bank. During the operation of the facility between June and September 1982, an unexpectedly high degree of metal wastage occurred from the external surfaces of this tube bank. Measures were taken to reduce the rate of metal wastage and extend the life of the tube bank, which was subsequently replaced in July 1983 after a total operating period of 1222 hours of coal burning. Using small-scale fluidized bed cold models, experimental investigations were carried out to determine measures to reduce the metal wastage. The results indicated that metal wastage would be reduced by the following changes: a reduction in the fluidizing velocity; the attachment of studs or axial fins to the tubes; a reduction in the height of the space between the distributor plate and the bottom of the tube bank; and the elimination, where possible of any large gaps within the tube bank. Such changes have been incorporated into the design of the replacement tube bank. This has now been installed and has experienced significantly less metal wastage. 9 references, 6 tables, 34 figures.

9544 **(DOE/ET/10393—1691) Research instrumentation: operating history and the installation of new systems.** McKendrick, D. (NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)). Sep 1984. Contract AI01-76ET10393. 214p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85001976.

Sampling systems are installed at the Grimethorpe experimental Pressurised Fluidised Bed Combustion Facility in South Yorkshire, England to enable samples of solids and gases to be extracted from the fluidised bed or the exhaust gas ductwork. Solids samples are collected for laboratory analysis using bed ash, primary cyclone captured solids, and fixed and traversing position dust probe sampling systems. Gas samples are analysed on-line during plant operation by individual systems developed to measure concentrations of O_2, SO_3, SO_2, CO, CO_2, and NO/sub x/. Batch sampling systems requiring laboratory analysis of the collected samples have also been developed to determine the concentrations of F, Cl and alkali vapour/aerosol in the exhaust gas from the combustor. The design, operation, and problems and modifications of these systems are described; the period covered is from April 1982 to March 1984.

9545 **(DOE/FC/10489—1694) Development of reliable predictive heat transfer correlations for low-rank coal-fired fluid bed combustors. Final report.** Grewal, N.S. (North Dakota Univ., Grand Forks (USA). Engineering Experiment Station). Feb 1984. Contract AT18-81FC10489. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004809.

(1) The proposed correlation of Equation (5) is recommended to predict the maximum value of heat transfer coefficient between a horzontal tube and a gas-solid fluidized bed of small particles under the conditions given. For high temperature applications (T/sub B/ > 600°C), the radiative component is important and was estimated following Baskakov et al. (2) The proposed correlation of Equation (8) was found reliable to predict the existing data on the maximum value of heat transfer coefficient between a horizontal tube bundle and a gas-solid fluidized bed of small particles under the conditions given. At high temperatures, the radiative component was estimated from the experimental data of Baskakov et al. (3) The correlation of Equation (8) predicted the GFETC data taken during the combustion of low-rank coal very well, when the contribution due to radiation was estimated following Baskakov et al. (4) The correlations proposed by Grewal and Bansal et al. were found to predict the data taken during low-rank coal combustion within +-25%, when the contribution due to radiation was included and estimated following Baskakov et al. (5) Finally, the correlations for large particles (anti d/sub p/ > 1mm) as proposed by Glicksman and Decker, Catipovic et al., Xavier and Davidson, and Zabrodsky et al. also predicted the data for low-rank coal fluidized bed combustor quite well, when the radiative component was estimated from the data of Baskakov et al. 64 references, 19 figures, 10 tables.

9546 **(DOE/FC/10614—T16) Fundamental combustion studies of low-rank coal slurries. Monthly progress report, 1 December-31 December 1984.** Germane, G.J.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 28 Dec 1984. Contract AC18-84FC10614. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005175.

Physical property characterization, including elemental analysis, ash, volatiles, moisture, sulfur and particle size determination has been accomplished for the virgin coal and two low-rank lignite slurries steam-dried at 300°C and 330°C. Similar elemental and proximate analyses have been conducted for the subbituminous coal slurry provided by the Grand Forks Project Office. Rheological tests using a capillary viscometer have been completed for a range of solids loadings and shear rates for the lignite slurry produced at a drying temperature of 300°C. Apparent viscosity comparisons with other slurries tested in an earlier program were made. A review of available nozzles and atomizers was conducted and several nozzles were identified for spray and combustion testing. Contact with manufacturers has indicated probable availability of at least one small-sized commercial nozzle for lab-scale tests. Apparatus for slurry spray characterization tests was fabricated to study techniques to isolate portions of the spray for particle size, velocity and trajectory measurements. The reactor facility was moved and refurbished in preparation for low rank coal slurry combustion tests. The first sample of the test slurry was received from the Grand Forks Project Office and solids and ash content were measured in initial characterization studies.

9547 **(DOE/PC/40268—T7) Investigation of pyrite as a contributor to slagging in eastern bituminous coals. Quarterly progress report No. 4, July 1, 1982-September 30, 1982.** (Foster Wheeler Development Corp., Livingston, NJ (USA)). Oct 1982. Contract AC22-81PC40268. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004219.

Five of the candidate coals were ordered and delivered. One sample did not meet specifications, and an alternate must be selected. Another sample was found to contain approximately twice as much ash as expected, and analysis had to be made to determine the impact of cleaning at the mine on the ash chemistry. Characterization of Illinois No. 6 coal, originally selected as a Class 1 coal, indicates it may be better suited for testing as a Class 3 coal. Instead of the pyrites being separable from the other mineral matter, they appear to be intimately mixed. Combustion testing began. Problems were encountered with small particulate migrating into the vena contracta at the entrance to the convection pass, depositing on the refractory whose temperatures approach 1800°F to 1900°F, sintering and forming a deposit which eventually chokes the passage. The molten phase bonding the deposit appears to be rich in silica and potassium. There is no evidence of deposits upstream or downstream of the accumulation. No fouling occurred, and slagging of heat transfer surface was minimal. The coal fired contained finely-sized pyrites. Washability tests began on the Upper Freeport, Indiana County, Pennsylvania, coal.

9548 **(DOE/PC/60802—1) Aerosol formation from pulverized coal combustion. Quarterly report No. 4.** Linak, W.P.; Peterson, T.W. (Arizona Univ., Tucson (USA). Dept. of Chemical Engineering). 1 Sep 1984. Contract FG22-83PC60802. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003318.

Progress achieved during the quarter ending September 1, 1984 is summarized. The following information is included: (1) determination of the submicron particle size distributions for the new high and low sodium Beulah lignites; (2) determination of the effect of staging, (SR = 0.8/1.2), on the submicron aerosol for the new lignites; (3) characterization of the fly ash sampled from the convection section during runs involving the new lignites; (4) characterization of the new coals and their major ash constituents; (5) further study of the particle probe characteristics; (6) development of a method to correct the furnace temperature profiles for radiation losses; (7) improved residence time calculations to incorporate the corrected temperature profiles and more accurate gas flow rates; (8) compilation of all major gas species, temperature and operating parametric data for all coal runs under all analyzed stoichiometric conditions; (9) plots of the major gas species and temperature versus distance and residence time for all coal runs under all analyzed stoichiometric conditions; and (10) start-up and calibration of flash vaporization-flame photometric detection equipment for future use in the analysis for sulfate species sampled with the low pressure impactor.

9549 **(ECN—83-022) Combustion efficiency and petrographic properties.** Vleeskens, J.M. (Netherlands Energy Research Foundation, Petten). Feb 1983. 10p. (CONF-830807—). Netherlands Energy Research Foundation, P.O. Box 1, NL-1755 ZG, Petten.

From International conference on coal science; Pittsburgh, PA, USA (15 Aug 1983).

Relation between petrographic properties and combustion efficiency of a number of coal samples is studied in an AFB-combustor. The efficiency depends on the combustor, coal and process parameters. Operating temperature was held at 855 deg C and excess of air was 34%. However, chemical and petrographic analysis methods are equally well suited to predict the relative combustion efficiency. Previous microscopic observation of the coal is necessary for correct interpretation of the analytical results.

9550 **(N—84-20526) Measurements in liquid fuel sprays.** Chigier, N. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). Apr 1984. 15p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 1-15, N—84-20525 11-07.

Techniques for studying the events directly preceding combustion in the liquid fuel sprays are being used to provide information as a function of space and time on droplet size, shape, number density, position, angle of flight and velocity. Spray chambers were designed and constructed for: (1) air-assist liquid fuel research sprays (2) high pressure and temperature chamber for pulsed diesel fuel sprays and (3) coal-water slurry sprays. Recent results utilizing photography, cinematography, and calibration of the Malvern particle sizer are reported. Systems for simultaneous measurement of velocity and particle size distributions using laser Doppler anemometry interferometry and the application of holography in liquid fuel sprays are being calibrated.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 0150009432, 9503, 9979, 9980

9551 **(ICTIS/M—0171) Second report on MINOS.** Burns, A.; Newby, M.; Winterton, J. (Bradford Univ. (UK). Working Environment Research Group). 1984. 41p. University of Bradford, Working Environment Research Group, England.

This report extends the Interim Assessment of MINOS (Mine Operating System) prepared for the NUM (National Union of Mineworkers) executive in September 1982 and published in November 1983. The NCB (National Coal Board) designed MINOS in the late 1970's as a highly centralized, hierarchically organized system of remote control and monitoring in mines. The report contains a clearer overview of the objectives of MINOS following further information released by the NCB. New developments of particular subsystems are outlined with an evaluation of existing installations. The report also provides an update of the installations, by subsystem and by NCB area, and presents new evidence on the degeneration of the incentive scheme. A re-evaluation of the threat to jobs arising out of the NCB programme for restructuring the industry using new technology is contrasted with the potential of a New Plan for Coal (30 refs.) (Available from IEA Coal Research, quote ICTIS/MO171)

9552 **(NP—5900350) Revised market guide for coal exports from the United States.** (ICF, Inc., Washington, DC (USA)). Jun 1984. 105p. NTIS, PC A06/MF A01. File Number DE85900350.

The world market for steam coal is assessed. In recent years, much has changed in the world coal markets and in the expected opportunities for coal exports from the US. As an example, the overseas steam coal exports climbed from about 2 million tons in 1979 to about 35 million tons in 1981. Since then the overseas steam coal exports have fallen to 27 million tons in 1982 and to 17 million tons in 1983. In addition, metallurgical coal exports to overseas customers dropped from 60 million tons in 1982 to 43 million tons in 1983. This market guide is divided into four sections: Section one contains a review of the most frequently asked questions by individuals interested in the overseas coal markets and the role of US producers in this market; Section two contains an overview of the market for US steam and metallurgical coal exports, including forecasts of import demands, potential US market share, and the factors affecting this market share; Section three contains an outline of the current structure of the steam coal export trade in the US and the potential developments that will influence its future, and Section four contains a review of the important data on the nature of the energy-using industries, utilities and power plants, cement plants, coal quality requirements, and ports of the major steam and metallurgical coal importing countries. 14 figures, 45 tables.

0160 Health And Safety

REFER ALSO TO CITATION(S) 0160009433, 9517, 9957, 10388, 10421

9553 **(NR—83/137a) Mutagenicity of fly ash samples in a test with the protozoan Paramecium tetraurelia.** Hooftman, R.N. (Nijverheidsorganisatie TNO, Delft (Netherlands). Hoofdgroep Maatschappelijke Technologie). Aug 1983. 24p. (In Dutch). Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Delft, Netherlands.

The mutagenicity of fly ash derived from combustion of coal was investigated in a test with the protozoan Paramecium tetraurelia. This unicellular organism is able to ingest particles of the size of those that are ingested and removed by the alveolar macrophages in the lung of man and other animals: in Paramecium, as in the macrophage, ingestion is followed by intracellular extraction. Both ash from the electrostatic filter and stack-ash were mutagenic in Paramecium. The results showed similarities with and some differences from those obtained in the Ames test. There are indications that the test with Paramecium is a sensitive test for the mutagenicity of complex wastes.

9554 **(NR—84/157) Preliminary literature study for a research programme on human toxicological effects of stack emissions of coal-burning installations.** Vink, G.J. (Nijverheidsorganisatie TNO, Delft (Netherlands). Hoofdgroep Maatschappelijke Technologie). May 1984. 58p. (In Dutch). Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Delft, Netherlands.

A preliminary study of literature data on human toxicological aspects of the stack emissions of coal-burning installations has been carried out for the Dutch 'National Research Program on Coal Technology'. The aim of the study was to contribute to the formulation of a research program on the biological effects of these emissions. The following subjects have been considered: human toxicological research, air pollutants from coal combustion, the effects of these components on man or mammals, the effects of total emissions and fly ash on man, mammals or in-vitro test systems. A survey of human toxicological research in the Netherlands on air pollutants is also given. Comparison of the expected concentrations of important emission components in the air with 'maximum immission concentrations' (MIC-values) and the 'lowest effect concentrations' (LEC) quoted in the literature leads to the conclusion that in the most unfavorable case, concentrations up to 50% of the MIC-values of sulfur dioxide and nitrogen oxides can be reached. Risks from these compounds may be expected to be highest where they are found together with fly ash with absorbed trace elements and polycyclic aromatic hydrocarbons. Uncertainties with regard to possible synergistic actions of these components in combination with fly ash form a problem for both short- and long-term exposure. Data on epidemiological research around stacks are scarce. Data about in-vitro research of fly ash supply useful additional information on specific toxic properties and reactions but these must be evaluated for clear interpretation. Proposals are made for further investigations. (In Dutch)

02 PETROLEUM

0201 Reserves

9555 **A preliminary estimate of world heavy crude oil and butimen resources.** Meyer, R.F.; Fulton, P.A. (US Geological Survey, Reston, VA 22092). pp 88-90 of The future of heavy crude and tar sands. Meyer, R.F. New York, NY 10020; McGraw Hill, Inc. (1984). (CONF-8202102—).

From 2. international conference on future of heavy crude and tar sands; Caracas, Venezuela (7 Feb 1982).

Since the First International Conference on the Future of Heavy Crude and Tar Sands was held in Edmonton, Alberta, Canada, in June 1979, several significant events have occurred bearing upon future development of these resources. Positive factors include the following: (1) a second conference was held in Caracas, Venezuela, in February 1982, insuring continued exchange of knowledge on resources, technology, and economics; (2) the

UNITAR/ UNDP Information Centre for Heavy Crude and Tar Sands has been established in New York and staffed with highly competent technical representatives from Canada and Venezuela, assuring a permanent organization for collection, collation, and dissemination of information on heavy crude oil and tar sands (bitumen) throughout the world; (3) draft definitions of heavy oil and tar sands have been written to assure standardization of information reporting; (4) Venezuela is aggressively pursuing the exploitation of its vast extra-heavy oil resources in the Orinoco heavy oil belt; (5) the U.S. Geological Survey, with the financial support of the U.S. Department of Energy, has initiated a study of U.S. heavy oil, tar sands, and shallow oil-field resources, the first such review in more than 15 years; (6) numerous pilot studies on heavy-oil recovery are being conducted in the United States and in most countries possessing heavy-oil or tar-sand deposits; (7) heavy-oil deposits not only have been identified offshore, but locally are being produced by thermal methods; (8) about 175 enhanced oil-recovery projects in heavy-oil reservoirs alone have been identified around the world; and (9) a combination of declining resources of crude oil lighter than 20° gravity API (.934 g/cm³), high crude oil prices, advances in recovery and upgrading technology, and desire for greater national energy self sufficiency have created incentives for the aggressive exploitation of heavy-oil and bitumen deposits.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 02020010441

9556 (N—84-29267) Fossil fuels. (Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia)). Jun 1983. 22p. NTIS, PC A08/MF A01.

In yearbook of the Bureau of Mineral Resources, Geological and Geophysics, Canberra, 1 July 1982-30 June 1983, 21-42, N—84-29266 19-42.

The Fossil Fuels Program of the Australian Bureau of Mineral Resources investigates sedimentary basins, their history, and crustal framework, in order to develop an understanding of the processes controlling the genesis and distribution of fossil fuels and to provide a basis for their exploration and assessment. Research from the following subprograms of the Fossil Fuel program was reviewed: (1) the origin of fossil fuels in space and time, (2) onshore sedimentary basin analysis, (3) geophysical investigations of the structure of onshore basins, (4) offshore sedimentary basins, and (5) modern marine processes.

9557 (NP—5900700) Development of a predictive model for porosity distribution in the Smackover Formation of southwest Alabama. Final report, 1983-1984. Benson, J. (Alabama Univ., University (USA). Dept. of Geology). 15 Nov 1984. 62p. School of Mines and Energy Development (SOMED), Box 6282, University of Alabama, University (Tuscaloosa), AL 35486. File Number TI85900700.

The Upper Jurassic Smackover Formation is the major hydrocarbon producer in the State of Alabama having produced over 69.5 million bbls of oil, 63 million bbls of condensate, and 237 million Mcf of gas since the initial Smackover discovery from Toxey Field, Choctaw County in 1967. Smackover hydrocarbon exploration is hampered in Alabama and throughout the Gulf Coast by the inability to effectively predict porosity distribution in the unit. This report represents the results of the first year of a study designed to develop a predictive model for porosity distribution in the Smackover of southwestern Alabama. This study is based on analysis of over 900 thin-sections from 70 wells in southwest Alabama. Eight lithofacies were recognized in the Smackover in the study area. These are: anhydritic mudstone, microcrystalline dolomite, oolitic grainstone, skeletal-peloidal grainstone/packstone, algal boundstone, finely-crystalline dolomite, coarsely-crystalline dolomite, and mudstone. Depositional porosity in the Smackover ranged from very high in the oolitic grainstone lithologies to very low in the mudstone lithologies. This depositional porosity, however, has been significantly modified by diagenesis. Smackover sediments have undergone a complex history of diagenetic modification which has included micritization, multi-stage cementation, multi-stage dissolution, dolomitization, and sulfate mineralization. These diagenetic processes have occluded primary porosity and, in some cases, produced secondary porosity in lithologies which lacked primary porosity. Four primary pore types have been recognized in the Smackover; primary interparticulate, oomoldic, dolomitic intercrystalline, and vuggy. The occurrence of these pore types indicates porosity distribution is controlled by paleotopography which significantly influenced depositional and diagenetic processes. 20 references, 14 figures.

9558 (RISO-M—2388) Simulations of a well test of the Dan Field ME-2 well. Reffstrup, J.; Klint Jensen, P. (Risoe National Lab., Roskilde (Denmark)). Feb 1984. 149p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85750128.

Results from a single well study of the ME-2 well in the Dan Field are presented. The study includes a detailed description and analysis of geological and geophysical reservoir data and a computer simulation of the first production test carried out for this well. The analysis of geological and geophysical data has shown that the reservoir is composed of chalk which can be divided into eight rock types. The permeability is generally low , and the irreducible saturations of water and oil are generally high The permeability is anisotropic with a vertical to horizontal permeability ratio of 0.2-1.1. Based on log data, expressions for the relationship between irreducible water saturations and porosity have been developed. It was found that the irreducible water saturation was inversely proportional to porosity. Using this developed relationship the extension of the transition zone between the water and oil zones could be determined. The three-phase three-dimensional black oil reservoir model BETA3A was used to simulate the drawdown and buildup tests carried out for the ME-2 well. The simulation showed that the formation permeability is close to the values obtained from core measurements indicating a non-fractured reservoir rock. A comparison between three phase and single phase simulations of the drawdown and buildup was carried out.

0203 Drilling And Production

9559 (DOE/BC/10069—27) Mechanism of oil bank formation, coalescence in porous media and emulsion and foam stability. Quarterly research progress report, July 1, 1984-September 30, 1984. Wasan, D.T. (Illinois Inst. of Tech., Chicago (USA). Dept. of Chemical Engineering). 1984. Contract AC19-79BC10069. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004001.

The relative permeability model for two phase flow in porous media (Wasan 1983; Ramakrishnan and Wasan 1984) provides the necessary fractional flow curves at a given capillary number. These curves can be utilized in modeling both enhanced secondary and tertiary recovery processes. Important parameters in the fractional flow curves of our relative permeability model are the residual wetting and nonwetting phase saturations in a low capillary number flooding process. To understand, what constitutes the residual saturations, this quarter we have studied the displacement of one incompressible fluid by another in a porous medium using the network representation. The Bernoulli percolation model for an infinite lattice graph is utilized in the interpretation of the capillary behavior of the medium, which ultimately determines residual saturations. The calculated capillary pressure-saturation relationship using Bethe lattice results agrees qualitatively with experimental data. 4 references, 2 figures.

9560 (DOE/BC/10354—14) Evaluation of methods of reducing permeability in porous rocks by in-situ polymer treatments. Summary for 1984. Willhite, G.P.; Green, D.W.; Vossoughi, S.; Young, T.S.; Thiele, J.L. (Kansas Univ., Lawrence (USA)). 1984. Contract AS19-80BC10354. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003920.

The general purpose of this research program is to investigate the application of gelled polymer systems for flow control in oil recovery processes involving fluid displacements. The work has been divided into five general areas: (1) characterization of gel systems and gels; (2) kinetics of gelation for chromium(III) systems; (3) rheological investigation of chromium(III) gels; (4) in-situ gelation of chromium(III) systems; and (5) permeability reduction by

injection of polymer and aluminum citrate. Progress in each of these areas is summarized.

9561 **(RISO-M—2421) Classification of reservoir simulators.** Bech, N. (Risoe National Lab., Roskilde (Denmark)). Feb 1984. 135p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85750118.

EFP.

Based on a literature survey a scheme is presented for the classification of reservoir simulators. The classification scheme is intended for the following use: To obtain an overview regarding existing reservoir simulators, their type and area of application. To review and list the various techniques and concepts that are applied within the field of reservoir simulation. To perform detailed comparison of simulators with respect to mathematical modelling and numerical solution techniques.

9562 **Effects of thermal and mechanical loading on PDC bit life.** Glowka, D.A.; Stone, C.M. (Sandia National Laboratory). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE13257**: 16(Sep 1984). (CONF-8409104—).

From 59. annual Society of Petroleum Engineers of AIME technical conference; Houston, TX, USA (16 Sep 1984).

The results of numerical analyses conducted to determine the effects of thermal and mechanical loading on the integrity of polycrystalline diamond compact (PDC) cutters during deep hole drilling are presented. Cutter temperature distributions for several drilling environments are combined with appropriate mechanical cutting loads to predict stress distributions for the study of cutter wear mechanisms. A discussion of wear mechanisms acting on the cutting structure is presented. Suggestions are presented, based on these analyses, for the operation of PDC bits to increase bit life in hard, abrasive rock drilling. Microstructural design considerations for the cemented carbide that supports the diamond layer are also discussed.

9563 **Blob-size distribution as a function of capillary number in sandstones.** Chatzis, I.; Kuntamukkula, M.S.; Morrow, N.R. (Univ. of Waterloo). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE13213**: 12(Sep 1984). (CONF-8409104—).

From 59. annual Society of Petroleum Engineers of AIME technical conference; Houston, TX, USA (16 Sep 1984).

Changes that occur, with increase in capillary number, in the detailed structure of residual oil trapped in water-wet sandstone core samples, have been investigated. The technique of using a nonwetting phase which can be solidified and separated from the porous medium has been applied using styrene monomer as the nonwetting phase and 2% $CaCl_2$ brine as the wetting phase. The size distributions of residual oil blobs, obtained under various flow conditions, were measured by both image analysis and Coulter Counter techniques. Specific features of the results were checked by optical and electron microscopy. The changes in size distribution and shapes of blobs provide insight into the mechanisms of trapping and mobilization of residual oil.

9564 **Effect of crude-oil-induced wettability changes on oil recovery.** Morrow, N.R.; Lim, H.T.; Ward, J.S. (New Mexico Inst. of Mining and Technology). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE13215**: 16(Sep 1984). (CONF-8409104—).

From 59. annual Society of Petroleum Engineers of AIME technical conference; Houston, TX, USA (16 Sep 1984).

Displacements in strongly water-wet cores are compared with results of similar tests for a mixed wettability condition induced by a selected crude oil. Cores exposed to crude oil gave weakly water-wet imbibition behavior and 30-65% improvement in microscopic displacement efficiency. Other characteristics were clean breakthrough and low relative permeability to water at residual oil saturation. Flow visualization experiments with crude oil in micromodels showed improved oil recovery from pore bodies with oil trapping occurring in pore throats. Capillary numbers for mobilization of residual oil from weakly water-wet systems were higher than for strongly water-wet systems. Contact angle measurements showed that adsorbed transition metal ions at a high energy surface could have a dominant effect on wetting behavior.

9565 **Influence of geologic discontinuities on hydraulic fracture propagation.** Warpinski, N.R.; Teufel, L.W. (Sandia National Laboratories). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE13224**: 12(Sep 1984). (CONF-8409104—).

From 59. annual Society of Petroleum Engineers of AIME technical conference; Houston, TX, USA (16 Sep 1984).

Geologic discontinuities, such as joints, faults, and bedding planes, in conjunction with the deviatoric in situ stress state, material properties, and permeability can significantly affect the overall geometry of hydraulic fractures. This can occur by arresting lateral or vertical propagation of a fracture, reducing total fracture length via fluid leakoff, limiting proppant transport and placement, and enhancing the creation of multiple or secondary fractures rather than a single planar hydraulic fracture. Results from mineback experiments (fracture experiments conducted in a tunnel so they can be excavated for observation of the results), laboratory tests and analyses of these data are integrated to describe the complex fracture behavior found and to provide guidelines for predicting when this complex fracturing will occur.

9566 **Determination of hydraulic fracture azimuth by geophysical, geological, and oriented-core methods at the multiwell experiment site, Rifle, CO.** Teufel, L.W.; Hart, C.M.; Sattler, A.R. (Sandia National Laboratories). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE13226**: 11(Sep 1984). (CONF-8409104—).

From 59. annual Society of Petroleum Engineers of AIME technical conference; Houston, TX, USA (16 Sep 1984).

A comprehensive program for prediction of hydraulic fracture azimuth is being conducted in the tight, lenticular, gas sandstone reservoirs of the Mesaverde Group in the Department of Energy's Multi-Well Experiment near Rifle, Colorado. Methods used in the program can be divided into two groups: 1) indirect, predictive techniques which determine either the principal paleostresses or in-situ stresses prior to fracturing and 2) direct observation from either geophysical detection and mapping of hydraulic fracture propagation or wellbore impression-packers of open-hole hydraulic fractures. Predictive methods which determine the paleostress directions include geologic observations of the orientation of normal faults and fractures at the surface and in oriented core and twinned calcite strain analysis of oriented core. These methods show a consistent direction of N75°W + or - 10° for the maximum horizontal paleo-stress. Predictive methods which determine the in-situ stress directions include 1) oriented core analysis using anelastic strain recovery measurements and differential strain curve analysis, 2) oriented caliper and televiewer logs to infer stress directions from wellbore breakouts, and 3) computer modeling of the horizontal stress directions due to gravitational loading of topographic relief. The results of these methods are fairly consistent, and are in general agreement with the paleo-stress results, but also suggest a possible 20° clockwise rotation with depth of the maximum horizontal in-situ stress from N89°W + or - 10° in the upper fluvial zone starting at 1330 m to N68°W + or - 9° in the marine zone ending at 2450 m.

9567 **A model for interference testing with wellbore storage and skin effects at both wells.** Oghe, D.O.; Brigham, W.E. (Stanford Univ.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE13253**: 14(Sep 1984). (CONF-8409104—).

From 59. annual Society of Petroleum Engineers of AIME technical conference; Houston, TX, USA (16 Sep 1984).

The availability of highly sensitive pressure gauges has made interference testing a practical and useful diagnostic tool in reservoir engineering. In conducting an interference test, the pressure transient is initiated at the active well and the pressure response is measured as a function of time at the observation well. These measurements provide quantitative estimates of the reservoir transmissivity and storativity. In addition, an interference test can provide a

qualitative indication of communication between two or more wells in the reservoir. Although the influence of wellbore storage and skin at the active well on the pressure response at the observation well (or the inverse case) has been examined extensively, only a few studies have been reported on interference testing with wellbore storage and skin at both wells. This paper presents a mathematical model for interference testing with wellbore storage and skin at both wells. It examines the effect on pressure response of wellbore storage and skin at both wells compared to the response when storage and skin exist in only one of the wells. The paper also presents a new correlating technique for combining the wellbore storage and skin variables in interference tests when wellbore storage exists in only one of the wells. With this correlation it is possible to display, on a single graph, data that would ordinarily require a number of type curves for various combinations of C / SUB D/ /r² /SUB D/ and C /SUB D/ exp (2s). When wellbore storage and skin exist in both wells, the shapes of the resulting type curves are quite different from those that are generated when storage and skin exist only in one of the wells. Thus, our original goal--to define a singlewell equivalent wellbore storage--was not achieved. However, the distinctive difference in shape allowed us to generate another correlating graph that should be useful for many (but not all) cases where storage and skin occur in both wells.

9568 **Further investigation of high-temperature alkaline floods.** Mehdizadeh, A.; Handy, L.L. (Univ. of Southern California). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* SPE13072: 14(Sep 1984). (CONF-8409104—).

From 59. annual Society of Petroleum Engineers of AIME technical conference; Houston, TX, USA (16 Sep 1984).

Effectiveness of alkalies such as NaOH, Na_2SiO_3 and Na_2CO_3 to recover residual oil during hot waterfloods (180°C) was investigated and compared. These alkalies with or without surfactants may be added to steam to enhance the oil recovery from that portion of the reservoir which is subjected to a hot waterflood during steam injection. Tertiary flood rate and concentration of the injected alkalies were changed and their corresponding effects on recovery efficiency, water-oil ratio, recovery mechanism and alkali consumption were studied. Some lower temperature floods were also performed using caustic. Dynamic interfacial tensions between the acidic crude oil and the alkaline solutions at different pH were measured at elevated temperatures up to 180°C using a drop weight technique. For some alkalies (e.g. NaOH), effect of salt and surfactant addition were also investigated.

9569 **Downhole steam generatora potential breakthrough in heavy oil recovery.** Stosur, J.J.G. (US Dept. of Energy). pp 744-748 of The future of heavy crude and tar sands. Meyer, R.F. New York, NY 10020; McGraw Hill, Inc (1984). (CONF-8202102—).

From 2. international conference on future of heavy crude and tar sands; Caracas, Venezuela (7 Feb 1982).

The development of the downhole generator began in 1978 with a contract to Rockwell International to identify and evaluate various approaches. Rockwell developed 14 options and determined that the high and low pressure combustion of hydrocarbon fuel were the two highest potential options. The highpressure unit carries out the combustion at a pressure greater than that of the reservoir, generates steam by direct contact, and injects the steam and combustion gases into the reservoir. The low-pressure unit vents the combustion gases back to the surface, generating the steam in a downhole heat exchanger. A heat balance for the high pressure unit with 87.2 percent of the heat output being injected into the formation. A similar analysis of the low pressure unit shows 92.2 percent useful heat injected into the formation. This slightly higher number is due to less energy output lost from surface facilities (mainly compressors). Based on this analysis, Rockwell was contracted to develop a low-pressure generator, Foster Miller Associates was contracted to develop a high-pressure generator, and Sandia Labs undertook the development of a highpressure generator in-house. The difference in the Foster Miller and Sandia design concepts is in the approach to ensuring complete combustion of the low-volatile fuel to avoid injection of carbon residue into the formation. Foster Miller incorporates a swirl air-flow pattern with a long, ceramic-lined throat to provide sufficient residence time for complete burning. Sandia creates a fuel-water emulsion on the surface. In the combustion chamber, the sudden flash of the water contained in each droplet essentially atomizes the fuel, causing more complete combustion.

9570 **Heavy oil and tar sand research and development at the US Department of Energy.** Stosur, J.J.G.; Lievens, E.J., Jr. (US Dept. of Energy). pp 47-52 of The future of heavy crude and tar sands. Meyer, R.F. New York, NY 10020; McGraw Hill, Inc. (1984). (CONF-8202102—).

From 2. international conference on future of heavy crude and tar sands; Caracas, Venezuela (7 Feb 1982).

With the probability of finding new, large oil reservoirs in the United States decreasing, attention is now turning to new or improved methods of oil recovery from known fields, generally referred to as enhanced oil recovery (EOR) methods. Among EOR activities, heavy oil and tar sand resource recovery has always occupied a special status due to unique problems that do not impact on other sources. Though heavy oil and tar sand resources are estimated to be much larger on a worldwide basis than light oil resources (the opposite is true for the United States), the production of heavy oil today is only a tiny fraction of the huge world petroleum production, and the production of bitumen from tar sand is negligible. The reason is obvious. When large, light oil reservoirs were discovered in the United States, followed by the discovery of even larger light oil reservoirs in the Middle East, the difficult-to-produce and equally difficult-to-refine heavy oil became displaced by the more valuable light oil resource. The decreased interest in the development of heavy oil stems from recovery problems due to its high viscosity in the reservoir.

9571 **Pilot test of steam with additives at Midway - Sunset field, California.** Kuuskraa, V.A.; Hammershaimb, E.C. (Lewin and Associates, Washington, DC). pp 773-783 of The future of heavy crude and tar sands. Meyer, R.F. New York, NY 10020; McGraw Hill, Inc. (1984). (CONF-8202102—).

From 2. international conference on future of heavy crude and tar sands; Caracas, Venezuela (7 Feb 1982).

A ten-month steam-with-additives (foam) pilot test was conducted in the northeast segment of the MidwaySunset field, California, as the first of five tests. A year of laboratory work preceded the field test and identified favorable surfactants and optimum injection methods for in-situ generation of foam. A significant improvement has occurred in oil production as a result of the field test. Production in the pilot area increased sixfold, from an average of 17 barrels a day at the end of 1980 to an average of over 100 barrels per day during the last three months of the test. A significant production increase was also noted in the surrounding pattern wells. The severe steam channeling that had occurred for the previous two years has been dramatically reduced; the water-cut has declined from over 90 percent in the past two years to an average of 66 percent for the last three months of the test. As a result, steam is being diverted to the unswept portion of the internal pattern and to oil zones in the surrounding patterns. The oil to steam ratio, the most critical economic parameter, has increased sixfold from a low of 0.04 (an uneconomic ratio) in 1980 to 0.26 in August 1981.

9572 **Microbial processes and the recovery of heavy petroleum.** Finnerty, W.R.; Singer, M.E. (Univ. of Georgia). pp 424-429 of The future of heavy crude and tar sands. Meyer, R.F. New York, NY 10020; McGraw Hill, Inc (1984). (CONF-8202102—).

From 2. international conference on future of heavy crude and tar sands; Caracas, Venezuela (7 Feb 1982).

A discussion on the application of microbial processes to oil production will necessarily fall short of precise or general solutions. Even as the petroleum engineer lacks definitive knowledge supported by comprehensive data bases on the chemical and physical structure of the oil reservoir, the microbiologist also lacks information necessary to critically address possible role(s) microorganisms may play in enhanced oil production. The areas of hydrocarbon and petroleum microbiology have produced an extensive literature over the past half century (Davis, 1967). Significant advances have occurred in the acquisition of definitive knowledge relating to the

physiological, biochemical, and genetic properties of a variety of hydrocarbon-utilizing microorganisms. The application of this knowledge has yet to be realized in direct application to enhanced oil recovery (EOR) or oil production. A consensus of opinion exists among many microbiologists that a potential use of microorganisms and their products has application to field problems. Microorganisms have been isolated that grow at the expense of heavy crude oil. These cultures exhibit many beneficial characteristics, producing products that significantly reduce surface tension and interfacial tension, as well as the viscosity of heavy oil under laboratory controlled conditions. The application of microbial processes and bioengineering to EOR and oil production are contingent upon acquisition and development of a definitive data base that offers justification for further development of this new technology. Results to date are highly promising and support the further development of biological processes in oil recovery and production.

0204 Processing

9573 **(NIPER—23-Vol.2) Processing and thermodynamics research, Volume II. Monthly progress report, November 1984.** (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). 14 Dec 1984. Contract FC01-83FE60149. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004851.

Data assembly is in progress on the Venezuelan Cerro Negro, California, Wilmington and Mexican Mayan crudes. A draft of a proposal is in preparation that might join this correlational work with complementary correlational work at the University of Oklahoma (Project BPT1). Cerro Negro 200 to 425°C and 425 to 550°C saturate fractions were analyzed with the CEC 21-103 mass spectrometer using ASTM method D2786, and experiments were devised to establish reproducibility of analyses with the KRATOS MS-50 (Project BPT2). Thermodynamic property measurements on organic nitrogen compounds included a liquid phase heat capacity study of 2,5-dimethylpyridine, and the oxygen sensitivity of phenanthridine was checked prior to bomb calorimetry (Project BPT3A). Heat capacity measurements on chroman are progressing well, and vapor pressure measurements of tetrahydrophenanthrene are in progress (Project BPT3B). Work was begun on the design and procurement of equipment necessary for construction of a bench scale catalytic cracking unit. The supercritical extraction unit is being assembled (Project OPT1). Thiopene separations were begun on Cerro Negro 425 to 550°C neutrals, and separation of sulfides from Cerro Negro 550 to 700°C and 700+°C neutrals was completed (Project OPT2). Preparations for PVT studies of methanol are nearing completion, and a list of critically needed PVT measurements was reviewed to help select the next compound for study. A possible candidate is hydrogen sulfide. (Project OPT3). Good progress continues in the treatment of the RP feed (Project OPT4) to recover Milspec F-76. It is anticipated that 85% recovery is possible by the chemical treatment/distillation process.

0206 Health And Safety

REFER ALSO TO CITATION(S) 0206009957, 10421

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 0207009979, 9980

9574 **(DOE/EIA—0109(84/10)) Petroleum Supply Monthly, October 1984.** (USDOE Energy Information Administration, Washington, DC). Dec 1984. 98p. NTIS, PC A05/MF A01; 1 - GPO; GPO Dep. File Number DE85002878.

This report contains detailed statistics on the supply and disposition of petroleum and petroleum products for October 1984. Information on crude oil, finished motor gasoline, distillate fuel oil, residual fuel oil, liquefied petroleum gases are included. Detailed statistics show production for the current month as well as the year-to-date. Data are also tabulated for the US Petroleum Administraction for Defense (PAD) Districts which include field production, refinery production, imports, stock withdrawal or addition, unaccounted for crude, net receipts, crude losses, refinery inputs, exports, products supplied, and ending stocks.

0209 Environmental Aspects

9575 **(NP—5900345) Migration of petroleum products in soil and ground water: principles and countermeasures.** Davis, J.B.; Farmer, V.E.; Kreider, R.E.; Straub, A.E.; Reese, K.M. (American Petroleum Inst., Washington, DC). Dec 1972. 41p. American Petroleum Inst., Washington, DC. File Number TI85900345.

Publication No. 4149.

The American Petroleum Institute has prepared this report to provide both theoretical background and general operating procedures for persons who may at some point be required to deal with oil spilled on land. The report is designed for the man in the field; the reader who wants more detail will find a number of references cited. Despite the extensive preventive measures taken by the petroleum industry and others, petroleum and petroleum products do escape on land from time to time. When they do so, rapid and informed action may be required to minimize fire and explosion hazards and to prevent or minimize contamination of soil and ground water. The action taken will benefit from some sort of contingency plan, since the people on the scene must react rapidly to a spill. This is especially so in the initial stages, when the extent of the contamination and the potential hazards may not yet be clear. Hydrocarbons can escape to the environment in such a variety of circumstances, however, that no plan can cover them all. Thus the man on the scene must have sufficient background to be able to assess with some knowledge the situation that he faces and to select the most effective courses of action. To provide that background, this report considers both principles and practice in each of six broad aspects of the problem: fire hazards and safety procedures; migration of oil products in soil and ground water; recovery and control of spilled oil; methods of identifying oil products; biological degradation of hydrocarbons; and experience with actual oil spills. 36 references, 16 figures, 2 tables.

0230 Properties

REFER ALSO TO CITATION(S) 0230009430, 9573

9576 **Characterization of Cerro Negro crude: physical and chemical separations.** Grizzle, P.L.; Green, J.B. (U.S. Dept. of Energy, Bartlesville, OK). pp 381-388 of The future of heavy crude and tar sands. Meyer, R.F. New York, NY 10020; McGraw Hill, Inc (1984). (CONF-8202102—).

From 2. international conference on future of heavy crude and tar sands; Caracas, Venezuela (7 Feb 1982).

The continuing decrease in the reserves of conventional crude oil has made it increasingly important that heavy petroleum be efficiently utilized. Consequently, improved refining or upgrading processes must be developed that can more economically and effectively convert these heavy oils to conventional products such as transportation fuels. One of the major problems in these developments arises from limited knowledge of the chemical composition of these materials. Thus, despite the complexity of these oils and problems associated with analyzing these relatively nonvolatile materials, techniques and methods must be developed for their characterization. Chemical and physical separations are an important first step in the detailed analysis of conventional oils if unique chemical class concentrates can be obtained (Dooley, et al., 1974). The same should hold true for heavy oils. In addition, compound class distributions obtained from separation schemes would yield important compositional data for process development (Sawatzky, et al., 1976; McKay, et al., 1981; Bollet, et al., 1981). This paper presents a separation scheme that is currently being developed for heavy petroleum. The scheme couples distillation and ion-exchange with solid-liquid chromatography in an attempt to prepare relatively narrow-boiling, chemically unique compound-class concentrates. For evaluation of the separations approach, a Cerro Negro crude oil from the Venezuelan Orinoco basin is being jointly characterized under a cooperative program between the U.S. Department of Energy and

INTEVEP, S.A. (Centro de Investigacion y Desarrollo de Petroleos de Venezuela).

9577 **Characterization of Cerro Negro crude: chemical analysis.** Sturm, G.P.; Scheppele, S.E. (U.S. Dept. of Energy, Bartlesville, OK). pp 389-396 of The future of heavy crude and tar sands. Meyer, R.F. New York, NY 10020; McGraw Hill, Inc. (1984). (CONF-8202102—).

From 2. international conference on future of heavy crude and tar sands; Caracas, Venezuela (7 Feb 1982).

Processing of heavy crude oils (Murphy, 1980) and residuals (Sikonia, et al., 1981; Aalund, 1981) is expected to contribute, along with other alternative fuel sources, to the solution of the problem of declining reserves of conventional crude oils. As supplies of conventional crudes decline, processing of alternative fuel sources to finished products and more efficient processing of conventional sources become more important and more economically viable. The importance of compositional knowledge of the feedstock and finished products for a given process has been recognized for many years (Lumpkin and Johnson, 1954). Detailed compound-type characterization of feedstocks and products can help the development and refinement of processes as well as provide information essential to understanding the mechanisms involved in the refining processes. Detailed characterization of complex mixtures such as conventional crudes, heavy crudes, and other fossil fuel liquids is simplified by distillation to produce cuts with manageable boiling ranges and by separation procedures which ideally produce fractions containing distinct compound classes. These fractions can be analyzed by infrared, ultraviolet, and fluorescence spectroscopy; nuclear magnetic spectroscopy; gas and liquid chromatography; and various mass spectrometric (MS) methods including GC/MS, low ionizing-voltage MS, field ionization MS, and probe distillation MS.

0240 Storage

9578 **(DOE/FE—0037/3) Strategic Petroleum Reserve. Quarterly report.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Strategic Petroleum Reserve). 15 Nov 1984. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004913.

This quarterly report, presented in five sections, describes activities undertaken with respect to the development of the Reserve during the period July 1, 1984 through September 30, 1984. The introduction and summary briefly discuss SPR program background and major activities of this quarter. Section II describes site development. Oil acquisition activities are reported in Section III. Other program topics are discussed in Section IV and information on the budget and cost of the Reserve is contained in Section V. The SPR underground storage facilities are being developed in three phases. Phase I, completed in 1980, consisted of the development of approximately 260 million barrels of storage capacity at five sites and construction of the St. James Marine Terminal. Phase II consists of storage capacity expansions at three Phase I sites by a total of 290 million barrels; cavern development is more than 75 percent complete. Phase III development consists of the construction of a new 140-million barrel storage site at Big Hill, Texas, and the further expansion of three existing SPR storage sites by a total of 60 million barrels. Phase III development continues to proceed on schedule. Leaching is now underway on all four Phase III caverns at Bryan Mound. At Big Hill, three cavern wells were completed this quarter, seven additional wells are in the process of being drilled, and site surface construction is approximately 20 percent complete. A contract for surface construction for the additional Phase III cavern at West Hackberry was awarded in September 1984. Site preparation for the single Phase III cavern at Bayou Choctaw has been completed and drilling of the wells will commence in October. During the quarter ending September 30, 1984, the total inventory of oil stored in the SPR reached 431,068,946 barrels, exceeding the Fiscal Year 1984 fill goal by approximately 2 million barrels. 2 tables.

0250 Combustion

REFER ALSO TO CITATION(S) 0250009550, 10233

9579 **(N—84-20527) Fuel spray diagnostics.** Bosque, M.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1984. 5p. NTIS, PC A14/MF A01.

In Combustion fundamentals research, 17-21, N—84-20525 11-07.

Several laser measurement methods are being studied to provide the capability to make droplet size and velocity measurements under a variety of spray conditions. The droplet sizing interferometer (DSI) promises to be a successful technique because of its capability for rapid data acquisition, compilation and analysis. Its main advantage is the ability to obtain size and velocity measurements in air-fuel mixing studies and hot flows. The existing DSI at NASA Lewis is a two-color, two-component system. Two independent orthogonal measurements of size and velocity components can be made simultaneously. It also uses an off-axis large-angle light scatter detection. The fundamental features of the system are optics, signal processing and data management system. The major component includes a transmitter unit, two receiver units, two signal processors, two data management systems, two Bragg cell systems, two printer/plotters, a laser, power supply and color monitor.

9580 **(N—84-20533) Effect of liquid droplets on turbulence structure in a round gaseous jet.** Mostafa, A.M.; Elghobashi, S.E. (California Univ., Irvine (USA)). Apr 1984. 9p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 67-75, N—84-20525 11-07.

A proposed two equation turbulence model for incompressible dilute two phase flows was validated and extended for steady incompressible two phase flow including phase change. The model was tested for the flow of a turbulent axisymmetric gaseous jet laden with multisize evaporating liquid droplets. Predicted results include distributions of the mean velocity volume fractions of different phases concentration of the evaporated material in the carrier phase turbulence intensity and shear stress of the carrier phase droplet diameter distribution and the jet spreading rate. Results are analyzed based on a qualitative comparison with the corresponding single phase jet flow.

03 NATURAL GAS

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 0302009512, 9556, 9557, 10441

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 0303009561, 9567

0305 Health And Safety

REFER ALSO TO CITATION(S) 0305009957

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 0306009979, 9980

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 0309009565, 9566

9581 (UCRL—89890-84) Western Gas Sands subprogram at Lawrence Livermore National Laboratory. Heuze, F.E. (Lawrence Livermore National Lab., CA (USA)). Dec 1984. Contract W-7405-ENG-48. 41p. (CONF-8411101—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004997.

From 3. annual western gas sands sub-program review; Morgantown, WV, USA (7 Nov 1984).

The objective of this program is to contribute to improvements in gas recovery from tight gas reservoirs by describing the mechanics of stimulation in fractured rocks. The period covered for this review is FY84 continuing in FY85. LLNL's approach is to: develop and validate computer models of the fracturing process, and improve the quality and relevance of selected geological input to the models: material properties and in-situ stresses. According to the objective and the approach, the WGS tasks are: 2-D models of arbitrary fracture propagation in jointed media; 3-D hydrofrac simulator development; mechanical and physical properties of WGS; and in-house stress tool. Highlights of accomplishments are summarized. The Unconventional Gas Program at LLNL provides DOE and Industry with: meaningful data on material properties used in hydrofrac design hardware to obtain geologic information such as in-situ stresses computer models to understand and optimize static and dynamic gas well stimulations.

0340 Combustion

REFER ALSO TO CITATION(S) 03400010233

04 OIL SHALES AND TAR SANDS

0401 Reserves And Exploration

REFER ALSO TO CITATION(S) 0401009555

9582 Characteristics of the PR Spring tar sand deposit, Uinta Basin, Utah, USA. Dana, G.F.; Sinks, D.J. (Laramie Energy Technology Center, US Dept. of Energy). pp 220-236 of The future of heavy crude and tar sands. Meyer, R.F. New York, NY, USA; McGraw Hill, Inc. (1984). (CONF-8202102—).

From 2. international conference on future of heavy crude and tar sands; Caracas, Venezuela (7 Feb 1982).

The Laramie Energy Technology Center (LETC) conducted a seven-corehole drilling program in the PR Spring tar sand deposit, southeastern Uinta Basin, Utah, during the summer of 1980. Three main tar sand zones in the southwestern and west-central portion of the deposit were correlated by cross sections, using six of the seven LETC coreholes. The saturated beds and zones are lenticular and discontinuous over both large and small areas. As determined by the LETC cores and twenty eight previously drilled cores in the deposit, from one to twenty seven separate tar sand beds at least one foot thick of continuous saturation exist in the deposit, the thickest of which is 10.7 m (35 ft) thick. Analytical results from the LETC cores and the twenty eight other cores were integrated to further evaluate tar sand characteristics of the deposit. The following general trends were noted: extracted permeability and extracted porosity decrease downdip (northwest); oil saturation decreases to the west-southwest; and water saturation decreases to the east.

0402 Site Geology And Hydrology

9583 A new approach to shale management in field-scale models. Haldorsen, H.H.; Lake, L.W. (Univ. of Texas). *SPEJ, Society of Petroleum Engineers Journal;* **24**: No. 4, 447-457(Aug 1984).

Virtually every sandstone reservoir contains significant amounts of shale. Although the sand/shale sequence in the wells may be known, a reliable reservoir description must define quantitatively the lateral continuity of the shale, the shale distribution in unsampled areas, and the effects of the shales on transport properties. This paper presents statistical techniques by which the lateral continuity and spatial disposition of shales can be estimated. These techniques rely on shale statistics from the wells and outcrop statistics from appropriate depositional environments. The resulting shale description can be conditioned to conform with the observations of the wells. The subsequent discretizing of the reservoir into gridblocks for numerical simulation yields large elemental units that usually contain both sand and shale. The paper concludes by showing how the permeability and porosity may be estimated from the disposition of shales within each block.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 0404009570

9584 (LA-UR—84-3673) ASPEN simulation of commercial HYTORT reactor configurations. Phillips, T.T.; Odell, K.A.; Parkinson, W.J.; Rex, R.C.; Janka, J.C. (Los Alamos National Lab., NM (USA); Hycrude Corp., Chicago, IL (USA)). 1984. Contract W-7405-ENG-36. 11p. (CONF-8411130—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003738.

From Eastern oil shale symposium; Lexington, KY, USA (27 Nov 1984).

The Phillips Petroleum Company recently sponsored a feasibility study of the HYTORT process for hydrogen retorting of eastern oil shale. As a result of their study, a new moving-bed vertical-shaft retort configuration was developed. Compared with earlier HYTORT reactor designs, this retort design features lower temperatures and a simplified gas flow scheme. It also eliminates the need for oxygen-hydrogen combustion within the retort itself that characterized earlier designs such as those modeled by the Los Alamos National Laboratory in 1981. The Cray-1 ASPEN flowsheet simulator at the Los Alamos National Laboratory was used to model the new, simplified Hot-Top HYTORT reactor configuration. The results are compared with earlier Los Alamos models of older reactor configurations and provide a quantitative indication of the progress of HYTORT process development efforts during the past four years. 7 references, 11 figures, 4 tables.

9585 (UCID—16986-84-3) Lawrence Livermore National Laboratory oil shale project quarterly report, July-September 1984. Lewis, A.E. (ed.). (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004986.

Highlights of progress achieved during the quarter ending September, 1984, are summarized. Additional parameter studies using our moving-bed retort model were completed for an external-combustion, hot gas retort. Previously reported studies focused on effects of variations in the temperature and flow rate of the recycle gas and the dimensions of the retort. More recently, we investigated the effects of variations in shale grade, water content, flow rate, particle size, and bed porosity. We also considered effects of permeability contrast within a retort. The LLNL one-dimensional model for simulating oil shale retorting in an aboveground, moving-bed retort was applied to the indirect mode of operation in which externally heated recycle gas provides the heat required for the retorting process. Variations in recycle-gas temperature and flow rate, shale flow rate, shale grade, water content, particle size distribution, bed porosity, uniformity of porosity, and retort dimensions were studied. We have been evaluating the results for determining hydrogen sulfide and trace sulfur in gases taken from the pyrolysis

portion of the retort after leaving the oil condensers, as determined by the triple quadrupole mass spectrometer (TQMS) for the retort runs R-2 through R-7. These runs were conducted in our hot solid retort system consisting of a fluidized bed pyrolyzer, a cascading bed combustor, and recirculating gas and solid streams. Differences had been noted between determinations of the H_2S by Draeger tubes and the portable on-line mini-quadrupole mass spectrometer (Analog Technology Corp. Automated Trace Gas Monitor Model 2001), and the grab samples run on the TQMS. The error was due to a complex mix of ion gauge response, gas viscosities and pumping speeds.

9586 **A steamflood in a Utah tar sand, USA.** Johnson, L.A.; Fahy, L.J. (Laramie Energy Technology Center, US Dept. of Energy). pp 727-736 of The future of heavy crude and tar sands. Meyer, R.F. New York, NY, USA; McGraw Hill, Inc. (1984). (CONF-8202102—).

From 2. international conference on future of heavy crude and tar sands; Caracas, Venezuela (7 Feb 1982).

A steamflood experiment in the Northwest Asphalt Ridge tar sand deposit near Vernal, Utah, U.S.A. was conducted in 1980. The test utilized two concentric inverted five-spot patterns covering an area of 0.25 acres (1,012 m^2). The zone tested was a 45 ft (14 m) thick sandstone in the Rimrock member of the Mesaverde formation. The zone was 78.9 percent saturated with a 12° API (986 kg/m^3) bitumen having a viscosity greater than 10^6 centipoise (10^3 Pa.s) at reservoir conditions. During the 160 day test, 65,700 barrels (10.4 dam^3) of water-equivalent steam was injected at an average rate and pressure of 410 BPD (965 m^3/d) and 460 psig (3.2 MPa). Production during the experiment totaled 1,150 barrels (183 m^3) of oil and 6,250 barrels (994 m^3) of water. Computer modeling of the test indicated about a 16 percent overall steam efficiency for the test. Modeling was also instrumental in the design and operation of the test.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 0405009588

9587 **Viscous characteristics of a Utah tar sand bitumen.** Christensen, R.J.; Dorrence, S.M.; Lindberg, W.R. (Sundstrand Corporation, Rockford, IL). *Fuel;* 63: No. 9, 1312-1317(Sep 1984).

The viscous behaviour of an extracted tar sand bitumen has been experimentally examined and the results summarized in this Paper. The material studied was from the Asphalt Ridge, Utah area. The viscosity of the bitumen has been determined as a function of temperature (293-422 K), toluene (solvent) content (0-10%), composition (0-14.6% asphaltenes), oxidation and shear history. In all cases studied, the Arrhenius plots were significantly non-linear at temperatures >373 K, with viscous behaviour becoming less sensitive to toluene content with increasing temperature. Low temperature behaviour was strongly dependent on toluene content. The presence of asphaltenes in the bitumen was shown to be a strong viscosity enhancer. Oxidation and shear history were also shown to measurably increase the bitumen viscosity.

0407 Health And Safety

REFER ALSO TO CITATION(S) 04070010421

0410 Enviromental Aspects

9588 **(DOE/LC/10843—1690) Investigation of acid drainage potential of Eastern oil shale. Final report.** Paciorek, K.L.; Kimble, P.F.; Atkins, H.M.; Masuda, S.R.; Kratzer, R.H. (Ultrasystems, Inc., Irvine, CA (USA)). May 1984. Contract AC20-82LC10843. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85001980.

The objective of the first phase was to establish, via a survey type of an investigation, the presence or absence of potential hazardous drainage production from Eastern oil shale commercialization. To provide background regarding the various aspects associated with utilization of Eastern oil shale, a brief literature study was compiled to include current information on variations in mineralization of shales with geographic location, types of retorting processes used and their effect on the shale components, as well as data on leaching studies performed to date. Eastern oil shale is vastly different from the Western shale; concepts developed for the latter, in particular with respect to leaching, cannot be applied here. Eighteen shales were investigated. Of these, four were spent shales and four were the corresponding raw shales. The remaining ten were representative samples from two cores from Kentucky and Alabama, five from each. All the raw shales studied contained pyrite; in some the carbonate present was sufficient to delay or entirely prevent acid production and iron mobilization. Results indicate that exposed raw Eastern shales will definitely produce acidic leachates, containing sulfate, iron, and alkaline earth metal ions, in a manner analogous to the acid drainage associated with Appalachian coal mining. Combusted shales from the multi-solid fluidized bed retort appear not to present a drainage hazard. The materials recovered from the Rockwell process, when exposed to acid, e.g., from drainage of raw shale, were found to liberate soluble iron. Consequently, co-disposal of raw and spent shales would result in environmentally unacceptable drainage. Based on the limited experimentation performed, the same would seem to apply to the shales subjected to the Hytort. Any predictions as to the behavior of non calcareous shales are merely extrapolations. 51 references, 22 figures, 14 tables.

9589 **Environmental and social issues of the Syncrude project.** Thompson, D.C.; Lund, C.N. (Syncrude Canada Ltd., 10030-107 Str., Edmonton, Alberta). pp 490-500 of The future of heavy crude and tar sands. Meyer, R.F. New York, NY, USA; McGraw Hill, Inc. (1984). (CONF-8202102—).

From 2. international conference on future of heavy crude and tar sands; Caracas, Venezuela (7 Feb 1982).

The Syncrude project is among the leaders in the areas of both environmental protection and engineering technology. Syncrude's goal is to minimize environmental and social impacts within economic limits and to reclaim disturbed lands to a biologically productive land use potential as good as, or better than, the original state. Three basic environmental concerns were addressed by Syncrude during the design phase: water management, air quality, and land reclamation and revegetation. Water quality concerns were mitigated by adoption of a zero discharge concept. Air quality concerns were addressed through design of air pollution control systems such that all relevant government standards are met. Syncrude's ongoing research in soil reclamation and revegetation has provided the methods required to achieve land reclamation goals. The city of Fort McMurray has now largely overcome problems associated with a rapid population growth resulting from development of oil sands plants in the area and appears well on its way to stability.

05 NUCLEAR FUELS

0503 Mining

REFER ALSO TO CITATION(S) 0503009629

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 05070010134

9590 **(CONF-8410173—4) Thermal compatibility studies of unirradiated uranium silicide dispersed in aluminum.** Wiencek, T.C.; Domagala, R.F.; Thresh, H.R. (Argonne National Lab., IL (USA)). Sep 1984. Contract W-31-109-ENG-38. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004037.

From International meeting on reduced enrichment for research and test reactors; Argonne, IL, USA (14 Oct 1984).

Powder metallurgy dispersions of uranium silicides in an aluminum matrix have been developed by the international Reduced Enrichment for Research and Test Reactors program as a new generation of proliferation-resistant fuels. A major issue of concern is

the compatibility of the fuel with the matrix material and the dimensional stability of this fuel type. A total of 45 miniplate-type fuel plates were annealed at 400°C for up to 1981 hours. A data base for the thermal compatibility of unirradiated uranium silicide dispersed in aluminum was established. No modification tested of a standard fuel plate showed any significant reduction of the plate swelling. The cause of the thermal growth of silicide fuel plates was determined to be a two-step process: (1) the reaction of the uranium silicide with aluminum to form $U(AlSi)_3$ and (2) the release of hydrogen and subsequent creep and pillowing of the fuel plate. 9 references, 4 figures, 6 tables.

0508 Spent Fuels Reprocessing

9591 (ETR—318, pp 199-201) **Impressions of a senior member of the board.** Terjesen, S.G. (Norsk Hydro, Oslo). 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85780073. (CONF-8306235—).

From Eurochemic experience; Mol, Belgium (9 Jun 1983).

The author's experience as a member of the board of Eurochemic is presented.

9592 **(LA—10169-MS) Nonaqueous processing methods.** Coops, M.S.; Bowersox, D.F. (Los Alamos National Lab., NM (USA)). Sep 1984. Contract W-7405-ENG-36. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005187.

A high-temperature process utilizing molten salt extraction from molten metal alloys has been developed for purification of spent power reactor fuels. Experiments with laboratory-scale processing operations show that purification and throughput parameters comparable to the Barnwell Purex process can be achieved by pyrochemical processing in equipment one-tenth the size, with all wastes being discharged as stable metal alloys at greatly reduced volume and disposal cost. This basic technology can be developed for large-scale processing of spent reactor fuels. 13 references, 4 figures.

9593 **(ORNL/TM—8668) Solvent extraction of heptavalent technetium and rhenium by tributyl phosphate. Consolidated Fuel Reprocessing Program and Basic Energy Sciences Programs.** Pruett, D.J. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 97p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85004948.

The literature pertaining to the solvent extraction of heptavalent technetium and rhenium from aqueous solution by tributyl phosphate (TBP) has been compiled, critically evaluated, and supplemented with new data in some areas. The effects of adding mineral acids, alkali metal nitrates, alkali metal chlorides, uranyl nitrate, thorium nitrate, and plutonium(IV) nitrate to these systems were also examined. Discussions of the possible nature of the organic-phase complexes are presented, along with values of ΔG, ΔH, ΔS, and the equilibrium constant for the extraction reaction in several systems. Mathematical models correlating the distribution behavior over a wide range of conditions were also developed. Equations are given for calculating the distribution coefficients for the extraction of Re(VII) or Tc(VII) from 0.2 to 4 M HCl by 0.339 to 2.90 M TBP at 298 to 333°K. Equations are given for calculating the distribution coefficients under the same conditions, but with HNO_3 (instead of HCl) present in the aqueous phase. 28 references, 27 figures, 3 tables.

9594 **(RFP—3565) Pyrochemistry at Rocky Flats. First edition.** Giebel, R.E. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). May 1983. Contract AC04-76DP03533. 14p. NTIS, PC A02. File Number DE85003984.

Pyrochemical and pyrometallurgical processes are utilized at Rocky Flats for plutonium recovery and purification. Many of these processes use molten salts and molten metals which are stirred together or equilibrated at 700 to 900°C, resulting in chemical reactions. In one case, an electric current is also applied. These processes include molten salt extraction (MSE) for the removal of americium from plutonium; salt cleanup (SCU) for the recovery of the americium and plutonium from the MSE spent salt; direct oxide reduction (DOR) for the conversion of plutonium oxide to plutonium metal; and two plutonium metal purification processes, electrorefining (ER) and pyroredox. The above processes also come under the heading of extractive metallurgy.

9595 **(RFP—3719) Redox behavior of plutonium in nitric acid process solutions.** Keane, J.E. Jr.; Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1980. Contract AC04-76DP03533. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005183.

The redox behavior of plutonium in nitric acid was studied under varying conditions of refluxing and evaporative boiling, ozonation, and aging. The effect of plutonium and nitric acid concentration, temperature, and catalysts on the oxidation of plutonium was investigated. 5 references, 5 figures, 1 table.

9596 **(WINCO—1027) Fluorinel Dissolution Process and Fuel Storage Facility shield integrity examinations.** Hochhalter, E.E. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Jan 1985. Contract AC07-84ID12435. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004920.

The Fluorinel Dissolution Process and Fuel Storage (FAST) Facility at the Idaho Chemical Processing Plant (ICPP), Idaho National Engineering Laboratory, will receive and store spent metal-clad fuel and then dissolve this fuel using the new Fluorinel Dissolution Process (FDP). An extensive examination program of the facility's radiation shielding was performed prior to hot operation. The various techniques used to complete this program are discussed. The results of the program are also described, as well as recommendations for shield examinations.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 0509009633, 10198

9597 **(GLC-RDG—42) Transportation of nuclear waste. 1973-1983.** Nangia, S.; Hamlyn, P. (Greater London Council (UK)). Aug 1983. 6p. British Library Lending Division, Boston Spa, Wetherby LS23 7BQ.

39 references are given to publications dated between 1966 and March 1983 on the transportation of nuclear waste, irradiated fuel elements and other radioactive materials, including brief indications of the subject matter of each item. Hazards, safety, regulations, social aspects and organizational problems are among the topics covered.

9598 **(ORNL/TM—9388) Impact of transporting defense high-level waste to a geologic repository.** Joy, D.S.; Shappert, L.B.; Boyle, J.W. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004786.

The Nuclear Waste Policy Act of 1982 (Public Law 97-425) provides for the development of repositories for the disposal of high-level radioactive waste and spent nuclear fuel and requires the Secretary of Energy to evaluate five potential repository sites. One factor that is to be examined is transportation of radioactive materials to such a repository and whether transportation might be affected by shipments to a defense-only repository, or to one that accepts both defense and commercial waste. In response to this requirement, The Department of Energy has undertaken an evaluation of the cost and risk associated with the potential shipments. Two waste-flow scenarios are considered which are related to the total quantity of defense high-level waste which will be placed in a repository. The low-flow case is based on a total of 6700 canisters being transported from one site, while the high-flow case assumes that a total of 20,000 canisters will be transported from three sites. For the scenarios considered, the estimated shipping costs range from $105 million to $257 million depending upon the mode of transport and the repository location. The total risks associated with shipping defense high-level waste to a repository are estimated to be significantly smaller than predicted for other transportation activities. In addition, the cost of shipping defense high-level waste to a repository does not depend on whether the site is a defense-only or a commercial repository. Therefore, the transportation con-

siderations are not a basis for the selection of one of the two disposal options.

0510 Marketing And Economics

REFER ALSO TO CITATION(S) 0510009849

0520 Waste Management

REFER ALSO TO CITATION(S) 0520009598, 9625, 9626, 9627, 9628, 9632, 9635, 10077, 10079, 10123, 10434, 10435, 10439, 10440, 10443, 10444

9599 **(AEEW-R—1713) Incorporation of low and medium level radioactive wastes (solids and liquids) in cement. 5th 6-monthly report January-June 1983.** Brown, D.J.; Palmer, J.D.; Smith, D.L. (UKAEA Atomic Energy Establishment, Winfrith). Oct 1983. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703455.

The testing of cemented waste specimens containing sodium nitrate and sodium sulphate has been carried out over a period of two and a half years. One set of samples is kept under environmental conditions which simulate the anticipated storage conditions and a second series is stored under water. Additional results are reported here from the long-term stability testing of these simulated cemented wastes. Some applications of the method developed for measuring the apparent viscosity of cement pastes are described. Some preliminary information is given on the assessment of cement-waste mixing equipment.

9600 **(AEEW-R—1728) Heat of hydration measurements on cemented radioactive wastes. Part 1: cement-water pastes.** Lee, D.J. (UKAEA Atomic Energy Establishment, Winfrith). Dec 1983. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703456.

This report describes the hydration of cement pastes in terms of chemical and kinetic models. A calorimetric technique was used to measure the heat of hydration to develop these models. The effects of temperature, water/cement ratio and cement replacements, ground granulated blast furnace slag (BFS) and pulverised fuel ash (PFA) on the hydration of ordinary Portland cement (OPC) is reported. The incorporation of BFS or PFA has a marked effect on the hydration reaction. The effect of temperature is also important but changing the water/cement ratio has little effect. Results from cement pastes containing only water and cement yield total heats of reaction of 400, 200 and 100 kJ/kg for OPC, BFS and PFA respectively. Using the results from the models which have been developed, the effect of major salts present in radioactive waste streams can be assessed. Values of the total heat of reaction, the time to complete 50 percent reaction, and the energy of activation, can be compared for different waste systems.

9601 **(AERE-G—3025) Review of the assessment of canister performance contained in KBS-3 - final storage of spent nuclear fuel.** Marsh, G.P. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Mar 1984. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703458.

The section in KBS-3 dealing with the fabrication sealing and long term stability of copper canisters for spent nuclear fuel is reviewed. It is concluded that the case for supporting the claim that copper canisters will last for up to 10^6 years is well founded on accepted scientific knowledge. Some factors requiring additional comment have been identified. However it is stressed that while consideration of these factors may cause some alteration in the metal thickness required to achieve the desired containment period they should not change the basic conclusion that copper canisters will last for many thousands of years.

9602 **(ANL—84-59) Radioactive liquid waste treatment facility.** Black, R.L. (Argonne National Lab., IL (USA)). Jul 1984. Contract W-31-109-ENG-38. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004832.

The Radioactive Liquid Waste Treatment Facility (RLWTF) at Argonne National Laboratory-West (ANL-W) in Idaho provides improved treatment for low-level aqueous waste compared to conventional systems. A unique, patented evaporated system is used in the RLWTF. SHADE (shielded hot air drum evaporator, US Patent No. 4,305,780) is a low-cost disposable unit constructed from standard components and is self-shielded. The results of testing and recent operations indicate that evaporation rates of 2 to 6 gph (8 to 23 L/h) can be achieved with a single unit housed in a standard 30-gal (114-L) drum container. The operating experience has confirmed the design evaporation rate of 60,000 gal (227,000 L) per year, using six SHADE's. 2 references, 2 figures, 2 tables.

9603 **(CONF-841157—39) Basalt glass: an analogue for the evaluation of the long-term stability of nuclear waste form borosilicate glasses.** Byers, C.D.; Jercinovic, M.J.; Ewing, R.C.; Keil, K. (Argonne National Lab., IL (USA); New Mexico Univ., Albuquerque (USA)). 1984. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004064.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

The long-term stability of nuclear waste form borosilicate glasses can be evaluated by understanding the processes that effect the long-term alteration of glass and by comparing laboratory alteration of synthetic basalt and borosilicate glasses with the observed stability of naturally occurring basaltic glasses in diverse geologic environments. This paper presents detailed electron microprobe analyses of naturally altered basaltic glasses (with maximum ages of 10,000 to 20 million years) from low-temperature environments. These results are compared to laboratory data on the corrosion of a synthetic basaltic glass in MCC-1 tests (90°C, a SA/V of 0.1 cm^{-1} and time periods up to 182 days), MCC-2 tests (190°C, a SA/V of 0.1 cm^{-1} and time periods up to 210 days) and hydration tests in saturated water vapor (240°C, an estimated SA/V of $\sim 10^6$ cm^{-1} and time periods up to 63 days). Additionally, laboratory-induced hydration alteration of synthetic basalt and borosilicate glasses is compared. These preliminary experiments provide evidence that the alteration processes observed for natural basalt glasses are relevant to understanding the alteration of nuclear waste glass, as both appear to react via similar processes. 12 references, 6 figures, 1 table.

9604 **(CONF-850242—3) Critical (public) masses: a case study of a radioactive waste site.** Williams, R.G.; Payne, B.A. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004023.

From 7. symposium on management of uranium mill tailings, low-level waste and hazardous waste; Ft. Collins, CO, USA (6 Feb 1985).

Increasing public sensitivity to radioactive and other hazardous waste issues often results in opposition that ranges from presentations by individuals at various public meetings to organizations initiating legal action in the courts. Organized opposition to proposed plans by the US Department of Energy (DOE) for a Surplus Facilities Management Program site near Weldon Spring, Missouri, has emerged during the two years that DOE has been involved in developing plans for this waste management site. An important aspect in the development of the major interest group in this case was the reliance on extra-local expertise at both the state and national levels. The group received organizational strategies, information on radioactive waste, legal advice, and direction from state and local environmental interest groups and various state agencies. In this paper, we present the historical development of organized public response and agency response to DOE's plans for the Weldon Spring site. The role of the interest group has emerged as one of a watchdog, scrutinizing and evaluating data, publications, and plans. Other organizations now rely on the group as a clearinghouse for information. This case is of particular importance to other waste management projects because it demonstrates the effective use of networking between various interest groups and agencies from the local to the national level. We believe that the emergence of such groups and their ties with a variety of extra-local organizations will be the rule rather than the exception in future waste projects. Agency personnel and project sponsors will find that an interactive, cooperative approach with such groups is an effective way to resolve waste issues.

9605 **(DOE/SR/10714—1) Separation of high activity nuclear waste into chemically similar fractions. First annual report.** Davis, M.W. Jr. (South Carolina Univ., Columbia (USA). Dept. of Chemical Engineering). 20 Jan 1982. Contract AS09-81SR10714. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85005007.

This report summarizes the research performed on the following tasks: (1) Removal of cesium and strontium from acidic waste, (2) Platinum-group metal removal from acidic waste (palladium, rhodium and ruthenium), and (3) rare earth and actinide removal as a group from acidic waste. The elements are to be removed from a commercial nuclear fuel reprocessing liquid waste stream after separation of uranium and plutonium and before the solidification process that encapsulates the residual fission products in a solid permanent underground storage. It is of course understood that the recovery and purification of uranium and plutonium would be the principal reason for commercial reprocessing. The major accomplishment of the project has been the identification of two crown compounds (macrocyclic-polyethers) the first specific for cesium extraction and the second specific for strontium extraction in an organic matrix solution containing TBP, kerosene and liquid anion exchanger Didodecyl naphthalene Sulfonic Acid (DNS). Platinum group metal solvent extraction work has also focused on the removal of Pd from solutions of HNO_3 and HCl. Three crown compounds and two liquid anion exchange reagents were evaluated in an organic phase consisting primarily of TBP and kerosene. 10 figures, 8 tables.

9606 **(DOE/TRU—8302) Defense Transuranic Waste Program Strategy Document.** (USDOE Assistant Secretary for Defense Programs, Washington, DC). Jan 1984. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004301.

The Defense Transuranic Waste Program (DTWP) Strategy Document presents the general strategy for managing transuranic (TRU) waste materials generated during defense and research activities regulated by the US Department of Energy. The Strategy Document includes discussion of objectives and activities relating to the entire Defense Transuranic Waste Program. However, the primary focus is on the specific management responsibilities of the Transuranic Waste Lead Organization (TLO). The document also includes an updated summary of progress on TLO-managed activities over the past year.

9607 (ETR—318, pp 163-167) **Evolution of national policy in the Federal Republic of Germany on fuel cycle and radwaste management.** Schueller, W. (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen m.b.H., Eggenstein-Leopoldshafen (Germany, F.R.)). 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85780073. (CONF-8306235—).

From Eurochemic experience; Mol, Belgium (9 Jun 1983).

The historical evolution of the aim of fuel reprocessing, the development of international cooperation, the safety syndrome and its economic consequences and the present policy and responsibilities in spent fuel management in the Federal Republic of Germany are reviewed.

9608 **(FLPU—83-7) Groundwater discharge mapping at Altnabreac by thermal infrared linescan surveying.** Brereton, N.R.; Hall, D.H. (Institute of Geological Sciences, Harwell (UK). Fluid Processes Unit). Jul 1983. 51p. NTIS (US Sales Only), PC A04/MF A01. File Number DE84703462.

A thermal infra-red linescan survey has been carried out of the area around Altnabreac, Caithness. The objectives of the survey were: to assess the applicability of the technique to the location of springs discharging from peat covered crystalline rocks; to provide the locations of springs for a subsequent geochemical sampling programme; and to gain clearer understanding of the ground water circulation patterns in the area. The number and distribution of springs located by the survey has proved to be far greater than had been previously anticipated and the capabilities of the technique have been clearly demonstrated. The results, together with other geochemical and hydrogeological data, indicate that the majority of the springs represent near surface recent groundwaters circulating within the moraine deposits and weathered granite.

9609 **(PNL—4955-2) Approved reference and testing materials for use in Nuclear Waste Management Research and Development Programs.** Mellinger, G.B.; Daniel, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1984. Contract AC06-76RL01830. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85005098.

This document, addressed to members of the waste management research and development community summarizes reference and testing materials available from the Nuclear Waste Materials Characterization Center (MCC). These materials are furnished under the MCC's charter to distribute reference materials essential for quantitative evaluation of nuclear waste package materials under development in the US. Reference materials with known behavior in various standard waste management related tests are needed to ensure that individual testing programs are correctly performing those tests. Approved testing materials are provided to assist the projects in assembling materials data base of defensible accuracy and precision. This is the second issue of this publication. Eight new Approved Testing Materials are listed, and Spent Fuel is included as a separate section of Standard Materials because of its increasing importance as a potential repository storage form. A summary of current characterization information is provided for each material listed. Future issues will provide updates of the characterization status of the materials presented in this issue, and information about new standard materials as they are acquired. 7 references, 1 figure, 19 tables.

9610 **(PNL-SA—12321) Hot cell preparation of approved testing materials for the Materials Characterization Center.** Thornhill, R.E.; Knox, C.A. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 7p. (CONF-841157—32). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004578.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

It is important in nuclear waste repository development that testing be done with materials containing a radionuclide spectrum representative of actual wastes. To meet the need for such materials, the Materials Characterization Center (MCC) has prepared simulated high-level waste (HLW) glasses with radionuclides representative of about 10-, 300-, and 1000-year-old waste. A quantity of well characterized spent fuel also has been acquired for the same purpose. Glasses containing 10- and 300-year-old wastes, and the spent fuel specimens, must be fabricated in a hot cell. Hot cell conditions (high radiation field, remote operation, and difficulty of repairs) require that procedures and equipment normally used in materials preparation out-of-cell be modified for hot-cell applications. This paper discusses the fabrication of two glasses, and the preparation of test specimens of these glasses and spent fuel. One of the glasses is a 76 to 68 composition, which is fully loaded with actual commercial reactor fission product waste. The other glass contains simulated Barnwell Nuclear Fuel Plant waste, doped with different combinations of fission products and actinides. The spent fuel is a 10-year-old PWR material. Special techniques have been used to achieve high quality, well characterized testing materials, including specimens in the form of segments, wafers, cylinders, and powders of these materials. 3 references, 1 table.

9611 **(PNL-SA—12322) Standardized waste form test methods.** Slate, S.C. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 7p. (CONF-841157—33). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004544.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

The Materials Characterization Center (MCC) is developing standard tests to characterize nuclear waste forms. Development of the first thirteen tests was originally initiated to provide data to compare different high-level waste (HLW) forms and to characterize their basic performance. The current status of the first thirteen MCC tests and some sample test results is presented: The radiation stability tests (MCC-6 and 12) and the tensile-strength test (MCC-11) are approved; the static leach tests (MCC-1, 2, and 3) are being reviewed for full approval; the thermal stability (MCC-7) and microstructure evaluation (MCC-13) methods are being considered for the first time; and the flowing leach tests methods (MCC-4 and 5),

the gas generation methods (MCC-8 and 9), and the brittle fracture method (MCC-10) are indefinitely delayed. Sample static leach test data on the ARM-1 approved reference material are presented. Established tests and proposed new tests will be used to meet new testing needs. For waste form production, tests on stability and composition measurement are needed to provide data to ensure waste form quality. In transportation, data are needed to evaluate the effects of accidents on canisterized waste forms. The new MCC-15 accident test method and some data are presented. Compliance testing needs required by the recent draft repository waste acceptance specifications are described. These specifications will control waste form contents, processing, and performance. 2 references, 2 figures.

9612 **(PNL-SA—12325) Materials interactions test methods to measure radionuclide release from waste forms under repository-relevant conditions.** Strickert, R.G.; Erikson, R.L.; Shade, J.W. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 7p. (CONF-841157—30). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004529.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

At the request of the Basalt Waste Isolation Project, the Materials Characterization Center has collected and developed a set of procedures into a waste form compliance test method (MCC-14.4). The purpose of the test is to measure the steady-state concentrations of specified radionuclides in solutions contacting a waste form material. The test method uses a crushed waste form and basalt material suspended in a synthetic basalt groundwater and agitated for up to three months at 150°C under anoxic conditions. Elemental and radioisotopic analyses are made on filtered and unfiltered aliquots of the solution. Replicate experiments are performed and simultaneous tests are conducted with an approved test material (ATM) to help ensure precise and reliable data for the actual waste form material. Various features of the test method, equipment, and test conditions are reviewed. Experimental testing using actinide-doped borosilicate glasses are also discussed. 9 references, 2 tables.

9613 **(PNL-SA—12746) Gamma and alpha radiolysis of salt brines.** Gray, W.J.; Simonson, S.A. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 9p. (CONF-841157—29). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004551.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

Gamma radiolysis of Permian Basin brine leads to equilibrium gas pressure of about 100 atm. at 75°C and about 40 atm. at 150°C, providing the gas space is very small and/or the total dose is very high. Dose rate dependence is being investigated but is not yet established. Alpha radiolysis of Permian Bsin brine is still being pursued, but it is clear that equilibrium gas pressures will be much higher than with gamma radiolysis. Gas compositions in all cases have been about two parts H_2 to one part O_2. Efforts to simulate these results with computer models have been quite successful. 8 references, 6 figures, 1 table.

9614 **(RFP—3555) Rocky Flats Advanced Size Reduction Facility.** Mitchell, D.L.; Aguilar, P.G.; Williams, P.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1984. Contract AC04-76DP03533. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004097.

An Advanced Size Reduction Facility (ASRF) at Rocky Flats is now in the construction phase. The facility will be used to section plutonium contaminated gloveboxes and miscellaneous equipment to a size which can be easily handled and disposed of in approved waste containers. Central Research System 50 Master/Slave Manipulators and Programmedand Remote (PaR) manipulators will be utilized to remotely strip the gloveboxes and miscellaneous equipment of removable components and appendages. A plasma arc torch handled by a wall mounted PaR model 3000 manipulator will size reduce the glovebox to the desired sizes. The nominal capacity of the facility will allow processing of one glovebox (< 6 ft x 8 ft x 10 ft in dimensions) per eight hour shift, resulting in a greater than 50% reduction of waste shipping volume. 2 figures.

9615 **(RFP—3660) Integration of long-range planning for management of defense transuranic waste.** Gilbert, K.V.; McFadden, M.H.; Raudenbush, M.H.; Smith, L.J. (Rockwell International Corp., Golden, CO (USA)). [1985]. Contract AC04-76DP03533. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005169.

As described in The Defense Waste Management Plan, the defense TRU program goal is to achieve permanent disposal and end interim storage. TRU waste is currently stored at six Department of Energy (DOE) sites, and new waste is generated at several more sites. The Waste Isolation Pilot Plant (WIPP) project is well-defined, and it has been necessary to integrate the activities of other parts of the TRU program in support of DOE Headquarters policy and the WIPP schedules and technical requirements. The strategy is described in the Defense Transuranic Waste Program Strategy Document. More detailed, quantitative plans have been developed through the use of several system models, with a Long-Range Master Plan for Defense Transuranic Waste Management as the focal point for coordination of proposed plans with all the parties involved.

9616 **(RFP—3741) Low-level nitrate waste process development.** Arnold, P.M.; Johnson, A.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1985]. Contract AC04-76DP03533. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005180.

Thermal and chemical methods for denitrification of nitrate wastes have been investigated. Experiments were conducted using a high temperature fluid wall reactor to determine its nitrate/nitrite destruction efficiency on simulated Rocky Flats Plant and Savannah River Plant waste streams. These streams included nitrate contaminated soils and feeds containing surrogate fission-products. Various additives were tested to enhance nitrate destruction, reduce NO/sub x/ off-gas generation, and produce an acceptable final waste form. In addition, testing was completed with actual Rocky Flats Plant nitrate wastes on an aqueous process consisting of formic and sulfuric acid reflux, followed by evaporation of the liquid to dryness. Experimental results are discussed and conclusions are presented on both the thermal and the aqueous processes. An update of an earlier survey on nitrate waste generation and inventories at DOE facilities is also provided. 4 tables.

9617 **(RHO-RE-ST—29-P) Hot tests of the small portable arc saw using an electromechanical manipulator.** Deichelbohrer, P.D. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Sep 1984. Contract AC06-77RL01030. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85005148.

The Small Portable Arc Saw was tested at Los Alamos National Laboratory for use in size reduction of radioactively contaminated metallic scrap. A TRU-contaminated glovebox was dissected with an arc saw handled by an electromechanical manipulator. Satisfactory operation of the saw is reported. Some additional development to improve operation is identified. 5 references, 15 figures.

9618 **(SKBF-KBS-TR—83-23) Preparation of titanates and zeolites and their uses in radioactive waste management, particularly in the treatment of spent resins.** Hultgren, Aa.; Airola, C.; Forsberg, S.; Faelt, L. (Svensk Kaernbraenslefoersoerjning AB, Stockholm). May 1983. 75p. NTIS (US Sales Only), PC A04/MF A01. File Number DE84703457.

Work on the preparation of titanates and zeolites was started and their possible uses in the management of radioactive wastes proposed in the first years of the 1970's by the Department of Nuclear Chemistry at the Royal Institute of Technology in Stockholm and the Chemical Center of the University of Lund, respectively. The major part of these efforts was sponsored by the National Council for Radioactive Waste (Prav), while the concluding phase including an over-all system design study adapted to the Swedish nuclear power programme for an economic evaluation was sponsored by the KBS Division of the Swedish Nuclear Fuel Supply Co. The preparation work resulted in processes ready for industrial scale production of sorbents of qualities adequate for applications in radioactive waste treatment. The essential effort was devoted to the

treatment of spent resins from nuclear power plants by transfer to their radioactive contents to titanates and zeolites, which can then be sintered to stable ceramic bodies (the PILO process). The economic evaluation indicated a significant economic incentive for the introduction of the PILO process if an incineration step is included for all types of spent resins. The essential efforts and results from this programme are summarized in this report.

9619 **(SKBF-KBS-TR—83-42) Final disposal of high levels waste and spent nuclear fuel. Foreign activities.** Gelin, R. (Svensk Kaernbraenslefoersoerjning AB, Stockholm). May 1984. 68p. NTIS (US Sales Only), PC A04/MF A01. File Number DE84703463.

Foreign and international activities on the final disposal of high-level waste and spent nuclear fuel have been reviewed. A considerable research effort is devoted to development of acceptable disposal options. The different technical concepts presently under study are described in the report. Numerous studies have been made in many countries of the potential risks to future generations from radioactive wastes in underground disposal repositories. In the report the safety assessment studies and existing performance criteria for geological disposal are briefly discussed. The studies that are being made in Canada, the United States, France and Switzerland are the most interesting for Sweden as these countries also are considering disposal into crystalline rocks. The overall time-tables in different countries for realisation of the final disposal are rather similar. Normally actual large-scale disposal operations for high-level wastes are not foreseen until after year 2000. In the United States the Congress recently passed the important Nuclear Waste Policy Act. It gives a rather firm timetable for site-selection and construction of nuclear waste disposal facilities. According to this act the first repository for disposal of commercial high-level waste must be in operation not later than in January 1998.

9620 **(WIPP-DOE—208) Waste Isolation Pilot Plant project progress report for quarter ending September 30, 1984.** (USDOE Albuquerque Operations Office, NM. Waste Isolation Pilot Plant Project Office). 1984. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003928.

Progress in the site construction and the design and engineering of the Waste Isolation Pilot Plant is reported. Technical and institutional activities and scientific and experimental studies are summarized.

9621 **Regional waste treatment with monolith disposal for low-level radioactive waste.** Forsberg, C.W. (Oak Ridge National Laboratory, Oak Ridge, Tennessee). *Nuclear and Chemical Waste Management;* 4: No. 4, 313-328(1983).

An alternative system is proposed for the disposal of low-level radioactive waste. This system, called REgional Treatment with MOnolith Disposal (RETMOD), is based on integrating three commercial technologies: automated package warehousing, whole-barrel rotary kiln incineration, and cement-based grouts for radioactive waste disposal. In the simplified flowsheet, all the sludges, liquids, resins, and combustible wastes are transported to regional facilities where they are incinerated. The ash is then mixed with special cement-based grouts, and the resulting mixture is poured into trenches to form large waste-cement monoliths. Wastes that do not require treatment, such as damaged and discarded equipment, are prepositioned in the trenches with the waste-cement mixture poured on top. The RETMOD system may provide higher safety margins by conversion of wastes into a solidified low-leach form, creation of low-surface area waste-cement monoliths, and centralization of waste processing into a few specialized facilities. Institutional problems would be simplified by placing total responsibility for safe disposal on the disposal site operator. Lower costs may be realized through reduced handling costs, the economics of scale, simplified operations, and less restrictive waste packaging requirements.

9622 **Sorption of anions of iodine by iron oxides and kaolinite.** Couture, R.A.; Seitz, M.G. (Argonne National Laboratory, Argonne, IL). *Nuclear and Chemical Waste Management;* 4: No. 4, 301-306(1983).

The sorption of iodide, iodate, and periodate ions by kaolinite, hematite and pelagic red clay in buffer solutions and sea water was studied. Iodate ions (IO^-_3) are strongly absorbed by hematite (Fe_2O_3) at pH values up to 9. The reaction is rapid and reversible and apparently occurs by replacement of OH^- ionson the surface. Periodate ions (IO^-_4) are more strongly sorbed by Fe_2O_3 than IO^-_3 ions; iodide ions (I^-) appear to be less strongly sorbed. At pH 4, hematite-free, goethitefree kaolinite sorbs IO^-_3 only slightly and I^- not at all. IO^-_3 is stable relative to I^- in the presence of oxygen, and occurs in surface waters and in seawater. Small amounts of finely divided iron oxides, which are present in many types of sediments, may play a major role in the geochemistry of iodine by absorbing IO^-_3. For example, in one experiment pelagic red clay was found to be about as active as reagent Fe_2O_3 in removing dissolved IO^-_3 from seawater. This result suggests that pelagic red clay may be an appropriate host for disposal of radioactive iodine-129. Experiments on sorption of radioactive I^- by sedimentary minerals are reported in the literature. In many of these experiments, some of the iodine is likely to have been in the IO^-_3 or IO^-_4 form, which would have been sorbed by iron oxide impurities. The results of sorption experiments with radioactive iodine are considered dubious unless the oxidation state and the mineralogical purity are established.

9623 **A comparison of the corrosion characteristics of synthetic monazite and borosilicate glass containing simulated nuclear defense waste.** Sales, B.C.; Boutner, L.A.; White, C.W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee). *Nuclear and Chemical Waste Management;* 4: No. 4, 281-289(1983).

The corrosion behavior of synthetic monazite and borosilicate glass in distilled water has been investigated by means of leachate conductivity measurements, ion-implanted marker techniques, solution analyses, and Rutherford backscattering depth profile analyses. Both nuclear waste form types were loaded with identical compositions and amounts of simulated Savannah River defense wastes. At 90°C, the 28-day release rate of Cs, Sr, and U from synthetic monazite was more than 20 times lower for each element than the corresponding release rate from glass. Under the same test conditions the dissolution rate of the monazite matrix ($LaPO_4$) was at least 1000 times lower than that of the borosilicate glass network. The effects of heavy particle radiation damage on the corrosion resistance of synthetic monazite and the temperature dependence of the corrosion rate are discussed. The present results indicate that at elevated temperatures (70-120°C) the long-term corrosion resistance of synthetic monazite containing Savannah River defense wastes will be superior to that of borosilicate nuclear waste glass by several orders of magnitude.

9624 **Water migration through compacted bentonite backfills for containment of high-level nuclear waste.** Westsik, J.H.; Hodges, F.N.; Kuhn, W.L.; Myers, T.R. (Pacific Northwest Laboratory, Richland, Washington). *Nuclear and Chemical Waste Management;* 4: No. 4, 291-299(1983).

Tests carried out with compacted sodium and calcium bentonites at room temperature indicate that bentonite backfills will effectively control water movement near a high-level nuclear waste package. Saturation tests indicate that water will rapidly diffuse into a dry bentonite backfill, reaching saturation in times on the order of tens of years. The apparent diffusion coefficient for sodium bentonite (about5 wt% initial water content) compacted to 2.1 g/cm^3 is 1.7 x 10^{-6} cm^2/sec. However, the hydraulic conductivities of saturated bentonites are low, ranging from approximately 10^{-11} cm/sec to 10^{-13} cm/sec over a density range of 1.5 g/cm^3 to 2.2 g/cm^3. The hydraulic conductivities of compacted bentonites are at least several orders of magnitude lower than those of candidate-host silicate rocks, indicating that most flowing groundwater contacting a bentonite backfill would be diverted around the backfill rather than flowing through it. In addition, because of the very low hydraulic conductivities of bentonite backfills, the rate of chemical transport between the containerized waste and the surrounding host rock will be effectively controlled by diffusion through the backfill. The formation of a diffusion barrier by the backfill will significantly reduce the long-term rate of radionuclide release from the waste package, an advantage distinct from the delay in release resulting from the sorptive properties of a bentonite backfill.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 0530009612, 9632

9625 (CONF-850242—4) Comparison of long-term stability of containment systems for residues and wastes contaminated with naturally occurring radionuclides at an arid site and two humid sites. Winters, M.; Merry-Libby, P.; Hinchman, R. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004028.

From 7. symposium on management of uranium mill tailings, low-level waste and hazardous waste; Ft. Collins, CO, USA (6 Feb 1985).

The long-term stability of near-surface containment systems designed for the management of radioactive wastes and residues contaminated with naturally occurring radionuclides are compared at the three different sites. The containment designs are: (1) a diked 8.9-m high mound, including a 3.2-m layered cap at a site (humid) near Lewiston, New York, (2) a 6.8-m-high mound, including a similar 3.2-m cap at a site (humid) near Oak Ridge, Tennessee, and (3) 4.8-m deep trenches with 3.0-m backfilled caps at a site (arid) near Hanford, Washington. Geological, hydrological, and biological factors affecting the long-term (1000-year) integrity of the containment systems at each site are examined, including: erosion, flooding, drought, wildfire, slope and cover failure, plant root penetration, burrowing animals, other soil-forming processes, and land-use changes. For the containment designs evaluated, releases of radon-222 at the arid site are predicted to be several orders of magnitude higher than at the two humid sites - upon initial burial and at 1000 years (after severe erosion). Transfer of wastes containing naturally occurring radionuclides from a humid to an arid environment offers little or no advantage relative to long-term stability of the containment system and has a definite disadvantage in terms of gaseous radioactive releases. 26 references, 3 figures, 4 tables.

9626 (EGG-M—24284) Use of a simplified pathways model to improve the environmental surveillance program at the Radioactive Waste Management Complex of the Idaho National Engineering Laboratory (INEL). Case, M.J.; Rope, S.K. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 12p. (CONF-841187—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004315.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

Systems analysis, including a simple pathways model based on first-order kinetics, is a useful way to design or improve environmental monitoring networks. This method allows investigators and administrators to consider interactions that may be occurring in the system and provides guidance in determining the need to collect data on various system components and processes. A simplified pathways model of radionuclide movement from low-level waste and transuranic waste buried at the Radioactive Waste Management Complex was developed (1) to identify critical pathways that should be monitored and (2) to identify key input parameters that need investigation by special studies. The model was modified from the Savannah River Laboratory DOSTOMAN code. Site-specific data were used in the model, if available. Physical and biological pathways include airborne and waterborne transport of surface soil, subsurface migration to the acquifer, waste container degradation, plant uptake, small mammal burrowing, and a few simplified food chain pathways. The model was run using a set of radionuclides determined to be significant in terms of relative hazard. Critical transport pathways which should be monitored were selected based on relative influence on model results. Key input parameters were identified for possible special studies by evaluating the sensitivity of model response to the parameters used to define transport pathways. A description of the approaches used and the guidance recommended to improve the environmental surveillance program are presented.

9627 (EGG-M—24884) Investigation of the subsurface environment at the Idaho National Engineering Laboratory Radioactive Waste Management Complex. Russell, B.F.; Mizell, S.A.; Hull, L.C.; Smith, T.H.; Lewis, B.D.; Barraclough, J.T.; Humphrey, T.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 14p. (CONF-841187—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004316.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

A comprehensive, 10-year plan to investigate radionuclide migration in the subsurface at the Radioactive Waste Management Complex (RWMC) has been prepared and initiated (in FY-84). The RWMC Subsurface Investigation is designed to address two objectives set forth by the DOE Idaho Operations Office: (1) determine the extent of radionuclide migration, if any, from the buried waste, and (2) develop and calibrate a computer model to simulate long-term radionuclide migration. At the RWMC, the Snake River Plain Aquifer underlies about 177 m of partially saturated, fractured basalts and thin sedimentary units. Three sedimentary units, accounting for no more than 20 m of the partially saturated thickness, appear to be continuous throughout the area. Thinner sedimentary units are discontinuous. Low-level waste and (prior to 1970) transuranic waste have been buried in the surficial sediments at the RWMC. The first burials took place in 1952. Due to the complicated disposal system, a comprehensive review of state-of-the-art vadose zone monitoring instrumentation and techniques, an analysis of conceptual migration pathways, and an evaluation of potential hazard from buried radionuclides were conducted to guide preparation of the investigation plan. The plan includes an overview of the RWMC facility, subsurface work conducted to date at the RWMC and other DOE laboratory facilities, an evaluation and selection of the methods and studies to be used, a radionuclide hazard evaluation, a cost analysis, and external peer review results. In addition, an Appendix contains the details for each method/study to be employed. 4 references, 5 figures, 1 table.

9628 (NUREG/CR—3941-Vol.1) Radionuclide migration around uranium ore bodies: analogue of radioactive waste repositories. Annual report, July 1982-June 1983. Airey, P.L. (Australian Atomic Energy Commission, Sutherland). Oct 1984. 154p. (AAEC/C—40-Vol.1). NTIS, PC A08/MF A01 - GPO* $5.50. File Number TI85901071.

A number of uranium ore bodies in the Northern Territory of Australia have been evaluated as geochemical analogues of high-level radioactive waste repositories. The aim of the study is to contribute to the understanding of the scientific basis for the long-term prediction of the transport of radionuclides. Particular attention is being paid to investigations of (i) mechanisms of mobilization and subsequent retardation of uranium series nuclides following the weathering of metamorphic host rocks, (ii) the role of iron minerals in the retardation of uranium and thorium, (iii) the role of groundwater colloids in the transport of radionuclides, (iv) experimental methods for studying the time dependence of adsorption coefficients, and (v) conceptual methods for studying the effect of transport of uranium series nuclides through crystalline host rocks over geological time. The possibility of incorporating certain transuranic and fission product elements into the analogue is discussed. 29 figures, 36 tables.

9629 (PNL-SA—12173) Identification of chemical processes influencing constituent mobility during in-situ uranium leaching. Sherwood, D.R.; Hostetler, C.J.; Deutsch, W.J. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1984. Contract AC06-76RL01830. 30p. (CONF-8408134—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85003645.

From Practical applications of ground water models symposium; Columbus, OH, USA (15 Aug 1984).

In-situ leaching of uranium has become a widely accepted method for production of uranium concentrate from ore zones that are too small, too deep, and/or too low in grade to be mined by conventional techniques. One major environmental concern that exists with in-situ leaching of uranium is the possible adverse effects mining might have on regional ground water quality. The leaching solution (lixiviant), which extracts uranium from the ore zone,

might also mobilize other potential contaminants (As, Se, Mo, and SO_4) associated with uranium ore. Column experiments were performed to investigate the geochemical interactions between a lixiviant and a uranium ore during in-situ leaching and to identify chemical processes that might influence contaminant mobility. The analytical composition data for selected column effluents were used with the MINTEQ code to develop a computerized geochemical model of the system. MINTEQ was used to calculate saturation indices for solid phases based on the composition of the solution. A potential constraint on uranium leaching efficiency appears to be the solubility control of schoepite. Gypsum and powellite solubilities may limit the mobilities of sulfate and molybdenum, respectively. In contrast, the mobilities of arsenic and selenium were not limited by solubility constraints, but were influenced by other chemical interaction between the solution and sediment, perhaps adsorption. Bulk chemical and mineralogical analyses were performed on both the original and leached ores. Using these analyses together with the column effluent data, mass balance calculations were performed on five constituents based on solution chemical analysis and bulk chemical and γ-spectroscopy analysis for the sediment. 6 references, 10 figures, 10 tables.

0540 Health And Safety

REFER ALSO TO CITATION(S) 0540009598, 9625, 9957

9630 **(CONF-841187—21) Some problems of risk balancing for regulating environmental hazards.** Gilbert, T.L. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004080.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

Rational regulation of environmental hazards may be based on the implicit underlying principles that government actions should enhance the average quality of life for those governed and maintain some degree of equity in the distribution of benefits, costs, and risks. Issues arising from these principles have practical implications for risk management policy in general and for the development and application of radiological protection criteria in particular. One of the issues is the appropriate distribution of expenditures for regulating different risks. The total resources available for risk regulation are finite; hence, minimizing the total risk subject to this constraint is an appropriate strategy for optimum risk management. Using a simple model, it is shown that this strategy leads to a distribution of expenditures between different risks such that a greater fraction is allocated to a risk with a higher cost of mitigation or control but the allocation is limited in such a manner that the fractional contribution of that risk to the total risk is also higher. The effect of deviating from this strategy is examined. It is shown that reducing a single risk of concern below the optimum value by a factor 1/F can increase the total risk by about F times the risk of concern. Taking into account the large uncertainties in risk assessment for establishing radiological protection criteria, it is argued that an optimum strategy for remedial action should (1) set basic risk limits as high as reasonable; (2) use realistic, case-specific data and analyses in deriving allowable residual contamination levels from basic risk limits; and (3) implement a policy of reducing residual contamination to levels that are as low as reasonably achievable (ALARA) within the constraints imposed by optimum resource allocation. 10 references.

9631 **(CONF-841187—22) Radiological protection guidelines for the Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program.** Gilbert, T.L. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004079.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

The need for a definitive basis for radiological guidelines and criteria for FUSRAP became apparent by 1981 and led ORO to sponsor a joint ANL/BNI/LANL/ORO effort under the chairmanship of Wayne Hansen (LANL) that resulted in a final FUSRAP radiological guidelines document in March 1983. A separate effort to develop guidelines for remedial action criteria for SFMP was in progress at PNL. The need to coordinate both efforts with impending revisions of DOE Radiological Protection Standards and impending new developments in EPA and NRC Radiological Protection Standards led to convening of the first DOE Workshop on Remedial Action Criteria in Gaithersburg, Maryland, in February 1984, followed by a second workshop in June 1984 at ANL. The major decisions were to base the criteria on dosimetry models and basic limits currently recommended by the International Commission on Radiological Protection, to emphasize the development and use of site-specific rather than generic guidelines and criteria for residual radionuclide concentrations in the ground, and to prepare a manual to accompany the guidelines that would present procedures and tables for deriving site-specific soil guidelines and criteria for the remedial action programs. A joint ANL/LANL/ORNL/PNL effort to prepare a definitive set of guidelines and a manual has been initiated. The scope, status, and current plans for this effort, and some of the key issues, are presented. 10 references, 1 table.

9632 **(NUREG/CR—3994) BURYIT/ANALYZ: a computer package for assessment of radiological risk of low-level radioactive waste land disposal.** Fisher, J.E.; Cox, N.D.; Atwood, C.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1984. Contract AC07-76ID01570. 134p. (EGG—2345). NTIS, PC A07/MF A01 - GPO. File Number TI85001619.

This report is a user's manual for a partially completed code for risk assessment of a low-level waste shallow-land burial site, to be used in the licensing of burial sites. This code is intended as a tool to be used for considering nuclide transport mechanisms, including atmospheric, groundwater, erosion, and infiltration to an underlying aquifer. It also calculates doses to individuals and the population through direct exposure, inhalation, and ingestion. The methodology of the risk assessment is based primarily on the response surface method of uncertainty analysis. The parameters of a model for predicting dose commitment due to a release are treated as statistical variables in order to compute statistical distributions for various dose commitment contributions. The likelihood of a release is also accounted for by statistically evaluating the arithmetic product of the dose commitment distributions with the probability of release occurrence. An example is given using the atmospheric transport pathway as modeled by a code called BURYIT. The framework for using other release pathways is described in this manual. Information on parameter uncertainties, reference site characteristics, and probabilities of release events is included.

9633 **(UCRL—91471) Probabilistic assessment of spent fuel shipping cask response to severe transportation accident conditions. Report summary.** Fischer, L.E.; Kimura, C.Y.; Witte, M.C. (Lawrence Livermore National Lab., CA (USA)). 1985. Contract W-7405-ENG-48. 8p. (CONF-850206—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017102.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

The licensing of commercial nuclear spent shipping casks in the United States is regulated by 10CFR71. In order to be licensed, casks must be designed not to fail under hypothetical test conditions specified in Appendix B of this regulation. Questions have been raised about the suitability of these tests in simulating actual transportation accident conditions. Our study addresses the adequacy of current regulations by comparing real-world accident conditions with regulatory test specifications using more complete accident statistics and more sophisticated structural analyses than have been used in studies to date. Our objective is to evaluate the protection provided by current regulations against severe accident conditions for commercial spent nuclear fuel casks that are transported by truck or rail. The complete spectrum of truck and rail accidents will be reviewed in order to determine the frequency (or infrequency) of cask failures during transportation accidents. 3 references, 1 figure.

0550 Regulations

REFER ALSO TO CITATION(S) 0550009847, 9880

9634 (PNL-SA—12616) Variance of measurements from a calibration function derived from data which exhibit run-to-run differences. Liebetrau, A.M. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 16p. (CONF-841077—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004554.

From Statistics symposium on national energy issues; Seattle, WA, USA (16 Oct 1984).

The volume of liquid in a nuclear process tank is determined from a calibration equation which expresses volume as a function of liquid level. Successive calibration runs are made to obtain data from which to estimate either the calibration function or its inverse. For tanks equipped with high-precision measurement systems to determine liquid level, it frequently happens that run-to-run differences due to uncontrolled or uncontrollable ambient conditions are large relative to within-run measurement errors. In the strict sense, a calibration function cannot be developed from data which exhibit significant run-to-run differences. In practice, run-to-run differences are ignored when they are small relative to the accuracy required for measurements of the tank's contents. The use of standard statistical techniques in this situation can result in variance estimates which severely underestimate the actual uncertainty in volume measurements. This paper gives a method whereby reasonable estimates of the calibration uncertainty in volume determinations can be obtained in the presence of statistically significant run-to-run variability. 4 references, 3 figures, 2 tables.

9635 (RFP—3645) Evaluation of a TRU waste counter for crated nuclear wastes. Harlan, R.A.; Shunk, E.R.; Gonzales, C.A. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Los Alamos National Lab., NM (USA)). [1984]. Contract AC04-76DP03533. 3p. NTIS, PC A02. File Number DE85003958.

The differential dieaway time technique developed by Los Alamos National Laboratory (LANL) is a very useful development for active interrogation nondestructive assay. Prompt neutrons from accelerator-neutron-induced fission provide the fissile assay response. That technology has been combined with passive interogation by neutron coincidence (or correlation) counting into one prototype device to assay fissile material in large crates of waste. This paper focuses on the first operational use of the LANL technology at the Rocky Flats Plant.

9636 (RFP—3696) Harris TOTAL data base system and Harris data base management system (DMS). Davies, R.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 16 Feb 1984. Contract AC04-76DP03533. 27p. NTIS MF A01; 2; GPO Dep. File Number DE85004966.

This paper discusses the Harris TOTAL data base system, the Harris data base management system (DMS) and their effects on a large scale interactive nuclear material accountability system. The accountability system was developed and is running on an H-800. This system consists of over three hundred user functions with over one hundred subroutines. Interactively generated batch (control point) jobs are used to handle the more time consuming functions. Over 190 users on over 60 terminals, produce approximately 5000 transactions and 26,000 data base updates per day. The data base currently has 72 TOTAL files consisting of 34 master files, 2 automatic master files and 36 variable files. DMS provides relief from task, system and catastrophic failures. This relief is provided in the form of logging, recovery, backup and statistics. The implementation, use and advantages of TOTAL and DMS with interactive systems will be shown.

9637 (SRDP-PR—2) Progress report for the period October 1981-June 1982. Adams, J.M. (ed.). (UKAEA Atomic Energy Research Establishment, Harwell. Safeguards R and D Project). Nov 1982. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703466.

This is the second report of work being carried out in the UK on Safeguards R and D in support of the IAEA. The majority of the work reported herein has been in progress throughout the period of this report, but some projects only commenced during this period. The projects included in the current UK Safeguards R and D Programme cover a wide diversity of aspects in the Safeguards field. It is convenient to classify the projects in terms of their applicability as follows, viz:- (a) service programmes (including training courses); (b) generic programmes; (c) FBR fuel cycle safeguards; (d) enrichment plant safeguards; and (e) stores safeguards and general accounting techniques.

9638 (SRDP-PR—3) Progress report for the period July 1982-June 1983. Adams, J.M. (ed.). (UKAEA Atomic Energy Research Establishment, Harwell. Safeguards R and D Project). Dec 1983. 44p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703467.

This is the third report of work being carried out in the UK on Safeguards R and D in support of the IAEA. The projects included in the current UK Safeguards R and D Programme cover a wide diversity of aspects in the Safeguards field, with the work on them being conducted at several locations within the UK. It is convenient to classify the projects in terms of their applicability: (a) service programmes (including training courses); (b) generic programmes; (c) FBR fuel cycle safeguards; (d) enrichment plant safeguards; and (e) stores safeguards and general accounting techniques.

9639 (SRDP-R—100) Use of calorimetry for plutonium assay. Mason, J.A. (UKAEA Atomic Energy Research Establishment, Harwell. Safeguards R and D Project). Dec 1982. 67p. NTIS (US Sales Only), PC A04/MF A01. File Number DE84703468.

Calorimetry is a technique for measuring the thermal power of heat-producing substances. The technique may be applied to the measurement of plutonium-bearing materials which evolve heat as a result of alpha and beta decay. A calorimetric measurement of the thermal power of a plutonium sample, combined with a knowledge or measurement of the plutonium isotopic mass ratios of the sample provides a convenient and accurate, non-destructive measure of the total plutonium mass of the sample. The present report provides a description, and an assessment of the calorimetry technique applied to the assay of plutonium-bearing materials. Types and characteristics of plutonium calorimeters are considered, as well as calibration and operating procedures. The instrumentation used with plutonium calorimeters is described and the use of computer control for calorimeter automation is discussed. A critical review and assessment of plutonium calorimetry literature since 1970 is presented. Both fuel element and plutonium-bearing material calorimeters are considered. The different types of plutonium calorimeters are evaluated and their relative merits are discussed. A combined calorimeter and gamma-ray measurement assay system is considered. The design principles of plutonium assay calorimeters are considered. An automatic, computer-based calorimeter control system is proposed in conjunction with a general plutonium assay calorimeter design.

9640 (SRDP-R—103) Outline appraisal of the use of ultrasonic techniques in nuclear materials safeguards. Silk, M.G. (UKAEA Atomic Energy Research Establishment, Harwell. Safeguards R and D Project). May 1983. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703469.

This review is intended to cover the fundamentals of physics, electronics and data handling techniques as they apply to the problem of the use of ultrasonics in nuclear safeguarding. A number of individual aspects of the total problem are first discussed and the advantages and problems raised by these are set out. The basis of the specification of ultrasonic probes for safeguarding purposes is then discussed. Finally some tentative conclusions are drawn. In its present form the document is intended as a listing of potential problems with some ideas for their solution. It is recognised that some problems are currently under investigation but it is assumed that it is better to provide as comprehensive a list as possible rather than to attempt to select only those problems which may not have yet been addressed.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

9641 (ORNL/TM—9430) Stable isotope customer list and summary of shipments: FY 1984. Tracy, J.G. (comp.). (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004764.

This compilation is published as an aid to those concerned with the separation and sale of stable isotopes. The information is divided into four sections: (1) alphabetical list of domestic and foreign customers, showing the stable isotopes purchased during the fiscal year; (2) alphabetical list of isotopes, cross-referenced to customer numbers and divided into domestic and foreign categories; (3) alphabetical list of states and countries, cross-referenced to customer numbers and indicating geographical concentrations of isotope users; and (4) tabulation of the shipments, quantities, and dollars for domestic, foreign, and project categories for each isotope.

0702 Radiation Sources

9642 (SAND—83-2155) Beneficial uses of nuclear by-products/sewage sludge irradiation project. Progress report, October 1982-March 1983. Pierce, J.D. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004096.

Gamma irradiation of various commodities in the Sandia Irradiator for Dried Sewage Solids (SIDSS) and the Gamma Irradiation Facility (GIF) continued during this reporting period. One truck-load of grapefruit was irradiated. Pelletized straw was irradiated to doses of 1, 5, 10, 20, and 40 megarads in SIDSS. Sludge, virus, and fungus samples were irradiated. Infected ground pork and infected pig carcasses were irradiated in the GIF as a method of Trichinella spiralis inactivation. Other experiments conducted in the GIF included irradiation of cut flowers to extend their shelf life and irradiation of kepone to induce its degradation. Waste Encapsulation and Storage Facility (WESF) capsule studies at ORNL and SNLA continued. A purchase order was placed for a prototype sludge solar dryer. Sewage Sludge Irradiation Transportation System (SSITS) cask activities included thermal stress analyses of cask performance following separation from the impact limiters during a fire. Analyses of cask performance, when loaded with six strontium-90 (Sr-90) capsules, also were done.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 0801009737

9643 (BNL—35440-Vol.1) Development of a commercial metal hydride process for hydrogen recovery. Volume I. Final report. Huston, E.L. (ERGENICS, Wyckoff, NJ (USA)). Oct 1984. Contract AC02-76CH00016. 243p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85004639.

The results of a one-year effort sponsored by the Department of Energy to investigate the technical prospects for separating or recovering hydrogen from industrial waste gas streams using metal hydride systems are summarized. The test results described in this report show that the recovery of hydrogen via metal-hydride technology, from candidate off-gas streams is complex due to the wide variety of impurities and their individual behavior. For all but the most simple cases, some stream pretreatment will be required in order to design for tolerable hydride inventories and lifetimes before replacement is required. It is evident that a great effort was made to elucidate hydride behavior and to find practical solutions to the complex problem. The extensive poisoning and regeneration data have provided a satisfactory basis for evaluating the general application of metal and alloy hydrides for hydrogen separation in chemical and petrochemical plants. The data show a very significant specificity of the effect of impurities on hydrides and it is evident that substantial additional testing would be required to match hydride, operating conditions, and pretreatments given the potential poisoning agents.

9644 (BNL—35440-Vol.2) Development of a commercial metal hydride process for hydrogen recovery. Volume II. Final report. Huston, E.L. (ERGENICS, Wyckoff, NJ (USA)). Oct 1984. Contract AC02-76CH00016. 349p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE85004640.

Volume II consists largely of experimental poisoning and regeneration on lower temperature AB and AB_5 alloys. A variety of alloys and gaseous impurities are covered along with important temperature effects. Included are performance models of hydrides that can be applied to process design and operating situations. Part 1 covers the effect of O_2 and CO on the AB_5 compound $LaNi_5$. Part 2 covers O_2 and CO effects on the AB compounds FeTi and (Fe, Mn)Ti. Part 3 covers O_2 and CO_2 effects on an Al-modified AB_5, $LaNi_{4.7}Al_{0.3}$, and a Ni-modified AB, $Fe_{0.35}Ni_{0.15}Ti$. Part 4 summarizes the adsorption/poisoning tests run on AB and AB_5 alloys. Part 5 covers the cyclic poisoning tests of $LaNi_5$ and (Fe,Mn)Ti with various new impurities: H_2S, CH_3SH, CO_2, NH_3, N_2, CH_4 and C_2H_4. Part 6 covers the CO and O_2 combination effects for (Fe, Mn)Ti and $LaNi_5$.

9645 Hydrogen sulfide as a source of hydrogen. Fletcher, E.A.; Murray, J.P.; Noring, J.E. (Department of Mechanical Engineering, University of Minnesota, Minneapolis, MN). *International Journal of Hydrogen Energy;* **9**: No. 7, 587-593(1984).

The authors suggest that hydrogen sulfide (that which is removed from fossil fuels as an unwanted waste product, as well as that which might be sought as a mineral in its own right), should be considered as a source of hydrogen. They discuss several techniques by means of which hydrogen sulfide might be thus exploited. The apparent problem of finding materials of construction for use in such processes is addressed.

0802 Storage

9646 (N—84-29356) Hydrogen storage in the form of metal hydrides. Zwanziger, M.G.; Santana, C.C.; Santos, S.C. (National Aeronautics and Space Administration, Washington, DC (USA)). May 1984. 9p. (NASA-TM—77453; CONF-781214—4). NTIS, PC A02/MF A01.

From 1. Brazilian energy congress; Rio De Janeiro, Brazil (12 Dec 1978).

Reversible reactions between hydrogen and such materials as iron/titanium and magnesium/ nickel alloy may provide a means for storing hydrogen fuel. A demonstration model of an iron/titanium hydride storage bed is described. Hydrogen from the hydride storage bed powers a converted gasoline electric generator.

9647 Kinetics and mechanism of the hydrogen evolution reaction on titanium in acidic media. Kelly, E.J.; Bronstein, H.R. (Oak Ridge National Laboratory, Chemistry Division, Oak Ridge, Tennessee). *Journal of the Electrochemical Society;* **131**: No. 10, 2232-2238(Oct 1984).

The effects of potential and pH on the rate of the hydrogen evolution reaction on zone-refined titanium have been determined in acidic sulfate and chloride media over the pH range of 0 to 4.0. In all cases, the cathodic Tafel slope is equal to -120 mV, i.e., (σE/ σlogi /SUB H/ ,∞I) /SUB pH/ = -2(2.303 RT/F). The reaction order with respect to proton activity, (-σlogi /SUB H/ ,∞I/σpH) /SUB E/ , exhibits a minimum value of 0.49 at pH = 1.83, and increases to limiting value of 1.0 with increasing or decreasing pH. A mechanism in agreement with the aforementioned observations has been proposed. The mechanism consists of two parallel paths for rate-determining proton discharge, one path involving the usual solvated proton and the other involving the adsorbed surface species $(TiOH)^+$ /SUB ads/ , followed by the fast recombination reaction. Langmuir adsorption kinetics apply to the adsorbed hydrogen atoms. The proposed mechanism is consistent wit what is known concerning the effect of potential upon the rate of absorption of hydrogen by the metal. The mechanism is also consistent with the

mechanism of active-state dissolution and passivation of titanium in acidic media.

9648 **Effect of crystallographic orientation of single-crystal RuO_2 electrodes on the hydrogen adsorption reactions.** Hepel, T.; O'Grady, W.E.; Pollak, F.M. (Department of Physics, Brooklyn College of Cuny, Brooklyn, New York). *Journal of the Electrochemical Society;* **131**: No. 9, 2094-2100(Sep 1984).

Linear potential scan and cyclic voltammetric behavior of the single-crystal RuO_2 (110), (001), (111), (101), and (100) surfaces in 0.5 mol/dm^{-3} H_2SO_4 solution have been studied. Significant differences in electrochemical characteristics observed in the hydrogen adsorption/desorption region have been correlated with the differences in composition and structure of the ideal, model surfaces of the RuO_2 single crystals. A cathodic/anodic pair of peaks H / SUB 2C/ , H /SUB 2A/ observed at about -0.3V (SCE) for the RuO_2 faces (110), (001), (111), and (101) has been ascribed to the reversible hydrogen adsorption/desorption on ruthenium sites. Another pair of peaks H /SUB 1C/ and H /SUB 1A/ at about E = 0 V (SCE), which appeared only on surfaces where oxygen is present, i.e., faces (110) and (001) has been attributed to the hydrogen chemisorption on oxygen sites. The adsorption Temkin coefficients g have been estimated. The correlation between the chemisorption peak currents and the surface density of the ruthenium sites is presented and discussed in detail. An interesting kinetic effect has been observed for the (100) RuO_2 surface. The peak structure for RuO_2 (100) cannot be correlated with the properties of the ideal surface, probably because of the surface restructuring effects. The best electrocatalytical properties have been found for the (101) RuO_2 surface, good ones have been found for the (111) face, and poor for (110) and (001) faces.

0803 Transport

REFER ALSO TO CITATION(S) 08030010229

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

9649 **(NP—5750142) Rape seed oil as diesel fuel.** Zoeylner, C.; Breum, C.; Wood Pedersen, J. (Jydsk Teknologisk Institut, Aarhus (Denmark)). Apr 1984. 60p. (In Danish). Jydsk Teknologisk Institut, Aarhus, Denmark. File Number TI85750142.

EFP-82.

Comparative short-time tests with diesel oil and rape seed oil in direct injection diesel engines have shown that power output and fuel consumption (l/hour) are more or less alike for the two types of fuel whereas the thermal efficiency is somewhat better for rape seed oil than for diesel oil. Moreover, it has been noted that the amount of soot in the exhaust is smaller for rape seed oil than for diesel oil. This implies that rape seed oil drops floating in the combustion chamber burn at least just as well as diesel oil drops in the same situation. Moreover, the test runs have confirmed that in diesel engines with direct fuel injection, a coke-like deposit is developed on the fuel nozzles and on the coldest surfaces in the combustion chambers when the rape seed oil is used as fuel. Various methods have been tested for determination of the tendency of diesel fuels to form coke in a test engine. A method by which the amount of coke deposited on the cylinder head is scraped off and weighed after 5 hours' operation of the engine was chosen. During the project work, the effect of additivies added to the rape seed oil on the formation of coke has been examined.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 0902209766

13 HYDRO ENERGY

1302 Site Geology And Meteorology

REFER ALSO TO CITATION(S) 13020010437

9650 **(NP—5750140) Narssaq glacier. Mass balance 1981 and 1982.** Clement, P. (Groenlands Geologiske Undersoegelse, Copenhagen (Denmark)). Nov 1982. 30p. (In Danish). NTIS (US Sales Only), PC A03. File Number DE85750140.

This report deals with the glaciological investigations made on Narssaq Brae by the Geological Survey of Greenland in 1981 and 1982. The investigations are part of a project concerning hydropower from town-near basins and are financially supported by the EEC. Narssaq Brae is a small cirque glacier in South Greenland north of Narssaq town with an area of 1.4 km^2. It is well defined, good maps are available and the glacier is thus suitable for mass balance measurements. Plans for using the meltwater for hydropower have been made by the Greenland Technical Organization. In May 1981, 10 stakes were drilled into the glacier. The winter balance was measured in snowpits and by depth soundings to be 2.3 mill. m^3. In late September, the summer balance was measured at the stakes to total 2.8 mill. m^3. The mass balance 1980/81 thus shows a deficit of 0.5 mill. m^3. In May 1982, the winter balance 1981/82 was measured to be 1.3 mill. m^3, a rather low value reflecting the relatively small winter precipitation in South Greenland this year. The summer balance was measured at the end of the ablation period to be 1.8 mill. m^3. The mass balance 1981/82 thus again shows a deficit of 0.5 mill. m^3. From a former mass balance study in 1970/71 three years of measurements can be compared. The mean annual ablation from the glacier can be calculated roughly as 2.3 mill. m^3, but large year-to-years variations exist.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 1400009968

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 1405009766, 9961, 9983

9651 **(DOE/ER/13197—T1) Methane producing bacteria: immunological characterization. Progress report, April-November 1984.** Conway de Macario, E.; Macario, A.J.L.; Wolin, M.J. (New York State Dept. of Health, Albany (USA). Center for Labs. and Research). 21 Nov 1984. Contract FG02-84ER13197. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004304.

A methodic study was carried out to develop methods for direct examination of samples from digestors to identify methanogens. A multiparametric approach was devised involving complementary techniques run in parallel or sequentially for identification of methanogens in microbial mixtures. It includes an immunoenzymatic assay, immunofluorence and Gram staining.

9652 **(KVL-JI-MEDD—43) Composting heat from solid stable manure.** Thostrup, P.; Berthelsen, L. (Kongelige Veterinaer- og Landbohoejskole, Tastrup (Denmark). Jordbrugsteknisk Inst.). Dec 1983. 82p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750133.

A description is given of the composting process, including some of the process parameters and construction parameters. An evaluation of some previous demonstration plants for composting manures is made, together with a description of existing composting plants. Furthermore economic calculations are made, and possibili-

ties of reducing the nitrogen (ammonia) loss from the composting are analysed.

9653 (N—84-21609) Results of the 1983 NASA/JPL balloon flight solar cell calibration program. Downing, R.G.; Weiss, R.S. (Jet Propulsion Lab., Pasadena, CA (USA)). Feb 1984. 17p. (NASA-CR—173465; JPL-PUB—83-100). NTIS, PC A02/MF A01.

The 1983 solar cell calibration balloon flight was successfully completed and met all objectives of the program. Thirty-four modules were carried to an altitude of 36.0 kilometers. The calibrated cells can now be used as reference standards in simulator testing of cells and arrays. Cell calibration data are tabulated as well as the repeatability of standard solar cell BFS-17A (35 flights over a 21-year period).

9654 (N—84-24655) Space plasma high-voltage drainage experiment (A0054). Taylor, W.W.L.; Komatsu, G.K. (TRW Space Technology Labs., Redondo Beach, CA (USA)). Feb 1984. 4p. NTIS, PC A09/MF A01.

In NASA. Langley Research Center, long duration exposure facility (LDEF), 82-85, N—84-24532 15-15.

The objectives of this experiment are to place large numbers of dielectric samples under electric stress in space; to determine their in-space current drainage behavior to recover, inspect, and further test these samples in laboratory facilities; and finally to specify allowable electric stress levels for these materials as applied to solar-array and thermal control coatings for prolonged exposure in space. These findings, in turn, will pace the design of encapsulated, lightweight, high-voltage solar arrays as well as the development of coating materials for spacecraft operation in energetic charged-particle environments such as that experienced at geosynchronous altitudes during magnetic substorms.

9655 (N—84-29307) Space Photovoltaic Research and Technology 1983. High Efficiency, Radiation Damage, and Blanket Technology. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 266p. (NASA-CP—2314; E—2005). NTIS, PC A12/MF A01.

This three day conference, sixth in a series that began in 1974, was held at the NASA Lewis Research Center on October 18-20, 1983. The conference provided a forum for the discussion of space photovoltaic systems, their research status, and program goals. Papers were presented and workshops were held in a variety of technology areas, including basic cell research, advanced blanket technology, and radiation damage.

9656 (N—84-29308) NASA-OAST photovoltaic energy conversion program. Mullin, J.P.; Loria, J.C. (National Aeronautics and Space Administration, Washington, DC (USA)). 1984. 7p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 1-7, N—84-29307 19-44.

The NASA program in photovoltaic energy conversion research is discussed. Solar cells, solar arrays, gallium arsenides, space station and spacecraft power supplies, and state of the art devices are discussed.

9657 (N—84-29309) Structurally stable, thin silicon solar cells. Arndt, R.A.; Meulenberg, A. (Communications Satellite Corp., Clarksburg, MD (USA)). 1984. 4p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 8-11, N—84-29307 19-44.

A fabrication process for structurally stable thin solar cell wafers that produce good power output after irradiation is described. The fabrication process is as follows. A 6 mil, circular wafer is oxidized on both sides. One side is then patterned with a rectangular array of holes in the oxide that are nominally 75 mils square and separated by 2 mil spacings. Wells are then etched into the silicon with KOH to a depth of 4 mils, leaving a 2 mil, unetched thickness. Two areas on the surface are left unetched to provide pads for bonding or testing. All oxide is then removed and the rest of the processing is normal the unetched face is used as the illuminated face. When all other processing is complete, a 2 X 2 cm cell is sawed from the starting wafer leaving a border that is approximately 10 mils wide. The effective thickness, determined by weighing an unmetallized sample, of such a cell is about 2.4 mil.

9658 (N—84-29310) Recent advances in LPE GaAs-based solar cells. Kamath, G.S.; Loo, R.Y.; Knechtli, R.C. (Hughes Research Labs., Malibu, CA (USA)). 1984. 6p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 12-17, N—84-29307 19-44.

Several modifications were made to an infinite solution liquid phase epitaxy system that help fabricate both GaAs-based cells and thin cells that effectively reduce power-to-weight ratio for space applications. The most important development is the multiwell crucible for multilayer growth. Using a split crucible in one system, as many as five layers were grown in succession with varying Al levels and dopants. The structures grown were used to produce thin GaAs cells only 10 to 20 microns thick and also to grow cascade cell components. Results of these studies are presented and their applications to the future development of GaAs-based cells are discussed.

9659 (N—84-29311) Process in manufacturing high efficiency AlGaAs/GaAs solar cells by MO-CVD. Yeh, Y.C.M.; Chang, K.I.; Tandon, J. (Applied Solar Energy Corp., City of Industry, CA (USA)). 1984. 7p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 18-24, N—84-29307 19-44.

Manufacturing technology for mass producing high efficiency GaAs solar cells is discussed. A progress using a high throughput MO-CVD reactor to produce high efficiency GaAs solar cells is discussed. Thickness and doping concentration uniformity of metal oxide chemical vapor deposition (MO-CVD) GaAs and AlGaAs layer growth are discussed. In addition, new tooling designs are given which increase the throughput of solar cell processing. To date, 2cm x 2cm AlGaAs/GaAs solar cells with efficiency up to 16.5% were produced. In order to meet throughput goals for mass producing GaAs solar cells, a large MO-CVD system (Cambridge Instrument Model MR-200) with a susceptor which was initially capable of processing 20 wafers (up to 75 mm diameter) during a single growth run was installed. In the MR-200, the sequencing of the gases and the heating power are controlled by a microprocessor-based programmable control console. Hence, operator errors can be reduced, leading to a more reproducible production sequence.

9660 (N—84-29312) Optimal design of GaAs-based concentrator space solar cells for 100 AMO, 80 deg C operation. Goradia, C.; Ghalla-Goradia, M.; Curtis, H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 9p. NTIS, PC A12/MF A01.

In Space Photovoltaic Research and Technology, 1983, 25-33, N—84-29307 19-44.

Using a detailed computer code and reasonable values of electrical and optical material parameters from current published literature, parameter optimization studies were performed on three configurations of GaAs-based concentrator solar cells for 100 AMO, 80 C operation. These studies show the possibility of designing GaAs-based solar cells with efficiencies exceeding 22% at 100 AMO 80 C and probable efficiency degradation of less than 15% after a 70% reduction in diffusion length in each cell region.

9661 (N—84-29313) Two-dimensional computer simulation of EMVJ and grating solar cells under AMO illumination. Gray, J.L.; Schwartz, R.J. (Purdue Univ., Lafayette, IN (USA)). 1984. 7p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 34-40, N—84-29307 19-44.

A computer program, SCAP2D (Solar Cell Analysis Program in 2-Dimensions), is used to evaluate the Etched Multiple Vertical Junction (EMVJ) and grating solar cells. The aim is to demonstrate how SCAP2D can be used to evaluate cell designs. The cell designs studied are by no means optimal designs. The SCAP2D program solves the three coupled, nonlinear partial differential equations, Poisson's Equation and the hole and electron continuity equations, simultaneously in two-dimensions using finite

differences to discretize the equations and Newton's Method to linearize them. The variables solved for are the electrostatic potential and the hole and electron concentrations. Each linear system of equations is solved directly by Gaussian Elimination. Convergence of the Newton Iteration is assumed when the largest correction to the electrostatic potential or hole or electron quasi-potential is less than some predetermined error. A typical problem involves 2000 nodes with a Jacobi matrix of order 6000 and a bandwidth of 243.

9662 **(N—84-29314) Radiation testing of GaAs on CRRES and LIPS experiment.** Trumble, T.M.; Masloski, K. (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH (USA)). 1984. 8p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 41-48, N—84-29307 19-44.

The radiation damage of solar cells has become a prime concern to the U.S. Air Force due to longer satellite lifetime requirements. Flight experiments were undertaken on the Navy Living Plume Shield (LPS) satellite and the NASA/Air Force Combined Release and Radiation Effects Satellite (CRRES) to complement existing radiation testing. Each experiment, the rationale behind it, and its approach and status are presented. The effect of space radiation on gallium arsenide (GaAs) solar cells was the central parameter investigaged. Specifications of the GaAs solar cells are given.

9663 **(N—84-29315) Solar cell degradation in proton radiation orbits.** Rauschenbach, H.S.; Yaung, J.Y. (TRW Space Technology Labs., Redondo Beach, CA (USA)). 1984. 7p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 49-55, N—84-29307 19-44.

Significant discrepancies have been observed between predicted and actual in-orbit silicon solar array degradation in orbits other than LEO (low Earth orbits) and GEO (geosynchronous orbit). These discrepancies have been diagnosed to arise probably from a combination of a lack of appropriate solar cell test data and from inadequacies in the models that relate the unidirectional and mono-energetic proton test data to the omnidirectional flux-energy spectra actually found in orbit. Relative damage coefficients and solar cell power outputs were discussed, and also were presented in graph form. Silicon and gallium arsenide solar cells were considered.

9664 **(N—84-29316) Model of solar cell proton damage.** Yaung, J.Y. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). 1984. 7p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 56-62, N—84-29307 19-44.

A short circuit current (I sub sc) degradation model for gallium arsenide (GaAs) solar cells irradiated by protons from low energy to 100 MeV was developed. This model was found to be satisfactory in predicting the I sub sc degradation of GaAs cells, but not that of silicon (Si) cells. A modification to the aforementioned model that preserves the optical wavelength dependency in the photogeneration of minority carrier pairs was described herein. Spectral Si and GaAs response and I sub sc for the Si and GaAs solar cells were discussed, and also were presented in graph form. The overall predictability of the modified model was deemed to be satisfactory.

9665 **(N—84-29317) Piecewise simulation proton test of gallium arsenide and thin silicon solar cells.** Peterson, D.G.; Billets, S.A. (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA (USA)). 1984. 11p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 63-73, N—84-29307 19-44.

Gallium Arsenide (GaAs) solar cells are viewed as a potential primary power source on certain future Earth orbiting satellites. However, the relative merits of gallium arsenide over silicon in a space radiation environment are largely unknown because a general degradation model for gallium arsenide does not exist. The results of a test simulating the proton radiation environment existing in a polar orbit and the concomitant effects on GaAs and thin silicon (Si) solar cells are presented. The objectives and methodology of the simulation test were discussed. The electrical characteristics of GaAs and Si solar cells are given in graph form. It was concluded that GaAs cells are viable for use on satellites in low Earth orbit.

9666 **(N—84-29318) Radiation tolerance of low resistivity, high voltage silicon solar cells.** Weizer, V.G.; Weinberg, I.; Swartz, C.K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 7p. NTIS, PC A12/MF A01.

In Space Photovoltaic Research and Technology, 1983, 74-80, N—84-29307 19-44.

The radiation tolerance of the following three low resistivity, high voltage silicon solar cells was investigated: (1) the COMSAT MSD (multi-step diffused) cell, (2) the MinMIS cell, and (3) the MIND cell. A description of these solar cells is given along with drawings of their configurations. The diffusion length damage coefficients for the cells were calculated and presented. Solar cell spectral response was also discussed. Cells of the MinMIS type were judged to be unsuitable for use in the space radiation environment.

9667 **(N—84-29319) On-orbit performance of LIPS gallium arsenide solar cell experiment.** Bavaro, T.; Francis, R.; Pennell, M. (Aerospace Corp., El Segundo, CA (USA)). 1984. 9p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 81-89, N—84-29307 19-44.

Telemetry from the Living Plume Shield's gallium arsenide solar panel experiment was evaluated to determine degradation. The data were culled to preclude spurious results from possible shadowing or inaccurate measurements on a cold array. Two independent methods were then used to obtain the maximum power points and the various characteristics of the solar array. Fill factor, open circuit voltage, short circuit current, and series and shunt resistances were examined. The data analysis concluded that, to date, nearly all of the solar array degradation is due to the reduction in the short circuit current.

9668 **(N—84-29320) Influence of oxygen on defect production in electron-irradiated, boron-doped silicon.** Deangelis, H.M.; Drevinsky, P.J. (Rome Air Development Center, Hanscom AFB, MA (USA)). 1984. 1p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 90 p., N—84-29307 19-44.

Deep level transient spectroscopy (DLTS) measurements were made on float-zone and crucible-grown, boron-doped silicon irradiated with 1-MeV electrons. The minority carrier trap attributed to a boron-related state, was not seen in low-resistivity, float-zone silicon. However, a new majority carrier trap was observed in these samples. In the case of more lightly doped material the minority carrier trap was present, and its introduction rate was lower in float-zone than in crucible-grown silicon. For 1- and 10-ohm-cm float-zone material that was oxidized during processing, the introduction rates for this trap were comparable to those for crucible-grown silicon. This behavior indicates that the minority carrier trap involves oxygen and that it may be due to a boron-oxygen complex. The majority carrier trap seen in heavily doped, float-zone silicon may also involve boron but not oxygen. Observed trap concentrations suggest that oxygen content in the regions examined by DLTS is affected by processing techniques. Other differences were observed in defect production and annealing behavior of electron-irradiated, float-zone and crucible-grown silicon.

9669 **(N—84-29321) Defect studies in one MeV electron irradiated GaAs and in Al/sub x Ga/sub 1-x As P-N junction solar cells.** Li, S.S.; Wang, W.L. (Florida Univ., Gainesville (USA)). 1984. 11p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 91-101, N—84-29307 19-44.

Deep level transient spectroscopy reveals that the main electron traps for one-MeV electron irradiated GaAs cells are E9c)-0.31, E(c)-0.90 eV, and the main hole trap is due to the level. Electron trap density was found to vary from 3/tens-trillion ccm for 2/one quadrillion cm 3/3.7 quadrillion cm for 21 sextillion cm electron fluence for electron fluence a similar result was also obtained for the hole trap density. As for the grown-in defects in the

Al(x)Ga(1-x)As p-n junciton cells, only two electron traps with energies of E(c)-0.20 and E(c)-0.34 eV were observed in samples with x 0.17, and none was found for x 0.05. Auger analysis on the Al(x)Ga(1-x) As window layer of the GaAs solar cell showed a large amount of oxygen and carbon contaminants near the surface of the AlGaAs epilayer. Thermal annealing experiment performed at 250 C for up to 100 min. showed a reduction in the density of both electron traps.

9670 **(N—84-29322) Cell and defect behavior in lithium-counterdoped solar cells.** Weinberg, I.; Mehta, S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 9p. NTIS, PC A12/MF A01.

In Space Photovoltaic Research and Technology, 1983, 102-110, N—84-29307 19-44.

Some n(+)/p cells in which lithium is introduced as a counterdopant, by ion-implantation, into the cell's boron-doped p-region were studied. To determine if the cells radiation resistance could be significantly improved by lithium counterdoping. Defect behavior was related to cell performance using deep level transient spectroscopy. Results indicate a significantly increased radiation resistance for the lithium counterdoped cells when compared to the boron doped 1 ohm-cm control cell. The increased radiation resistance of the lithium counterdoped cells is due to the complexing of lithium with divacancies and boron. It is speculated that complexing with oxygen and single vacancies also contributes to the increased radiation resistance. Counterdoping silicon with lithium results in a different set of defects.

9671 **(N—84-29324) Equivalent electron fluence for solar proton damage in GaAs shallow junction cells.** Wilson, J.W.; Stock, L.V. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). 1984. 6p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 112-117, N—84-29307 19-44.

The short-circuit current reduction in GaAs shallow junction heteroface solar cells was calculated according to a simplified solar cell damage model in which the nonuniformity of the damage as a function of penetration depth is treated explicitly. Although the equivalent electron fluence was not uniquely defined for low-energy monoenergetic proton exposure, an equivalent electron fluence is found for proton spectra characteristic of the space environment. The equivalent electron fluence ratio was calculated for a typical large solar flare event for which the proton spectrum is PHI(sub p)(E) A/E(p/sq. cm) where E is in MeV. The equivalent fluence ratio is a function of the cover glass shield thickness or the corresponding cutoff energy E(sub c). In terms of the cutoff energy, the equivalent 1 MeV electron fluence ratio is r(sub p)(E sub c) 10(9)/E(sub c)(1.8) where E(sub c) is in units of KeV.

9672 **(N—84-29325) Research directions and progress in SERI advanced high efficiency concepts program.** Benner, J.P.; Cole, L.A. (Solar Energy Research Inst., Golden, CO (USA)). 1984. 2p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 118-119, N—84-29307 19-44.

Novel solar cell designs and materials with the objective of achieving the maximum attainable photovoltaic conversion efficiencies are researched. Laboratory demonstrations of solar cells of greater than 30% efficiency under concentrated sunlight and thin film solar cells with one sun efficiencies of 17 to 20% are sought. These demonstrations are necessary intermediate steps towards the realization of very high efficiency, multi-bandgap, thin-film solar cells. Conversion efficiencies above 30% could be achieved by a cascade multijunction cell consisting of a high bandgap (1.7 eV) cell coupled optically and electrically on top of a lower bandgap (1.1 eV) cell. Recent improvements in peak currents of this interconnect are quite promising. However, this cell structure poses difficult problems for materials fabrication as a result of the combined requirements of choice of bandgaps, low defect density material, and high doping densities. Recent improvements in the quality of materials and newly proposed cell structures which may simplify fabrication are significant steps in the development of the multijunction concentrator solar cell.

9673 **(N—84-29326) Optimal design of high-efficiency single-junction and tandem concentrator space cells at 80 deg C and 100 SUNS.** Fan, J.C.C.; Palm, B.J. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1984. 8p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 120-127, N—84-29307 19-44.

Computer analysis was used to determine the AMO conversion efficiency of single-junction crystalline cells, two-cell and three-cell crystalline tandem structures operating under 100 suns and at 80 C. For optimally designed devices, the calculated efficiencies are 24% for single-junction cells, 33 to 35% for two-cell tandem structures, and 37 to 39% for three-cell tandem structures. Practical efficiencies are expected to be about 15 relative percentage points lower in each case.

9674 **(N—84-29327) Development of GaAs/Si and GaAs/Si monolithic structures for future space solar cells.** Spitzer, M.B.; Vernon, S.M.; Wolfson, R.G.; Tobin, S.P. (Spire Corp., Bedford, MA (USA)). 1984. 12p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 128-139, N—84-29307 19-44.

The results of heteroepitaxial growth of GaAs and GaAlAs directly on Si are presented, and applications to new cell structures are suggested. The novel feature is the elimination of a Ge lattice transition region. This feature not only reduces the cost of substrate preparation, but also makes possible the fabrication of high efficiency monolithic cascade structures. All films to be discussed were grown by organometallic chemical vapor deposition at atmospheric pressure. This process yielded reproducible, large-area films of GaAs, grown directly on Si, that are tightly adherent and smooth, and are characterized by a defect density of 5 x 10(6) power/sq cm. Preliminary studies indicate that GaAlAs can also be grown in this way. A number of promising applications are suggested. Certainly these substrates are ideal for low-weight GaAs space solar ells. For very high efficiency, the absence of Ge makes the technology attractive for GaAlAs/Si monolithic cascades, in which the Si substrates would first be provided with a suitable p/n junction. An evaluation of a three bandgap cascade consisting of appropriately designed GaAlAs/GaAs/Si layers is also presented.

9675 **(N—84-29328) Development of a 30 percent efficient 3-junction monolithic cascade solar cell.** Lewis, C.R.; Dietze, W.T.; Ludowise, M.J. (Varian Associates, Inc., Palo Alto, CA (USA)). 1984. 8p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 140-147, N—84-29307 19-44.

The individual subcells of the 3-junction monolithic cascade concentrator cell are grown lattice mismatched with respect to each other, if appropriate grading layers are inserted between the mismatched layers. Under these conditions, negligible degradation of the properties of either underlying or overlying material results, and high-efficiency subcells are produced by this technique.

9676 **(N—84-29329) High-efficiency solar cells fabricated by vacuum MO-CVD.** Fraas, L.M.; Cape, J.A.; Partain, L.D.; Mcleod, P.S. (Chevron Research Co., Los Angeles, CA (USA)). 1984. 7p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 148-154, N—84-29307 19-44.

High-efficiency, monolithic, two-color, three-terminal solar cells were fabricated by a novel growth technique, vacuum metal-organic chemical vapor deposition. The technique uses the expensive metal alkyls efficiently and toxic gases sparingly. The fact that the outer chamber is constructed of nonbreakable stainless steel is an attractive safety feature associated with this deposition system.

9677 **(N—84-29340) High speed, low cost, LEO-thermal-cycling facility.** Hart, R.E. Jr.; Sidorak, L.G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 5p. NTIS, PC A12/MF A01.

In Space Photovoltaic Research and Technology, 1983, 223-227, N—84-29307 19-44.

The design and operations of a low cost, high rate thermal cycling facility designed for LEO conditions is described. Thermal cycling facilities were constructed with various design criteria. Some were designed to duplicate as closely as possible the conditions a cell or module would encounter while in orbit about the Earth. A typical facility to perform this type of cycling was a large vacuum system with liquid nitrogen cooled walls. The cells were heated by an AMO spectrum solar simulator, then a shutter was closed allowing the cells to give up their heat to the cold walls. This system was good at duplicating the orbital conditions but was slow and very costly to operate. Other systems used a gas atmosphere and heated the cells with radiant heat and cooled the cells by moving them into close proximity to a cold plate. The systems greatly increased the cycle times. Other systems moved the heating and cooling atmosphere into and out of the test areas and achieved reasonable cycle rates. All these systems, however, are expensive to operate.

9678 **(N—84-29345) High-efficiency Conventional Cells Workshop.** Fan, J.C.C. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1984. 2p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 251-252, N-84—29307 19-44.

Participants expressed more interest in GaAs cells than in Si cells. For silicon cells, the beginning of life efficiency is not a major problem but more research is needed in the end of life efficiency. The beginning of life efficiency of GaAs cells must be brought up to 20% at AMO. More proton damage tests must be conducted. Liquid phase epitaxy technology is current but chemical vapor deposition technology is more flexible. There are no obvious problems in limiting process yields. Technology transfer should occur when market demands are generated.

9679 **(N—84-29348) Flat-plate solar array project: experimental process system development unit for producing semiconductor-grade silicon using the silane-to-silicon process. Final Report, April 1979-December 1981.** (Union Carbide Corp., Tonawanda, NY (USA); Jet Propulsion Lab., Pasadena, CA (USA)). 1983. 356p. (NASA-CR—173762). NTIS, PC A16/MF A01.

The process technology for the manufacture of semiconductor-grade silicon in a large commercial plant by 1986, at a price less than $14 per kilogram of silicon based on 1975 dollars is discussed. The engineering design, installation, checkout, and operation of an Experimental Process System Development unit was discussed. Quality control of scaling-up the process and an economic analysis of product and production costs are discussed.

9680 **(N—84-29351) Surface and allied studies in silicon solar cells.** Lindholm, F.A. (Florida Univ., Gainesville (USA)). Nov 1983. 39p. (NASA-CR—173761; JPL—9950-895). NTIS, PC A03/MF A01.

Two main results are presented. The first deals with a simple method that determines the minority-carrier lifetime and the effective surface recombination velocity of the quasi-neutral base of silicon solar cells. The method requires the observation of only a single transient, and is amenable to automation for in-process monitoring in manufacturing. This method, which is called short-circuit current decay, avoids distortion in the observed transient and consequent inacccuracies that arise from the presence of mobile holes and electrons stored in the p/n junction spacecharge region at the initial instant of the transient. The second main result consists in a formulation of the relevant boundary-value problems that resembles that used in linear two-port network theory. This formulation enables comparisons to be made among various contending methods for measuring material parameters of p/n junction devices, and enables the option of putting the description in the time domain of the transient studies in the form of an infinite series, although closed-form solutions are also possible.

9681 **(N—84-30552) Development of alternative energy science and engineering in the Caribbean. Final Report.** Bonnet, J.A. Jr. (Puerto Rico Univ., San Juan). Dec 1983. 48p. (PB—84-181106). NTIS, PC A03/MF A01.

The conclusions and recommendations of the Solar Energy Utilization Workshop for the Caribbean Basin were summarized. Wind power utilization and biomass energy production were discussed briefly. Solar energy conversion research at the University of Florida was presented.

9682 **(N—84-33210) Particle environment. Final Report, 5 November 1981-4 November 1982.** Gordon, W.L.; Hoffman, R.W. (Case Western Reserve Univ., Cleveland, OH (USA)). Sep 1984. 24p. (NASA-CR—173888). NTIS, PC A02/MF A01.

The charging and discharging characteristics of an electrically isolated solar array segment were studied in order to simulate discharges seen during geomagnetic substorms. A solar array segment was floated while bombarded with monoenergetic electrons at various angles of incidence. The potentials of the array surface and of the interconnects were monitored using Trek voltage probes to maintain electrical isolation. A back plate was capacitively coupled to the array to provide information on the characteristics of the transients accompanying the discharges. Several modes of discharging of the array were observed at relatively low differential and absolute potentials (a few kilovolts). A relatively slow discharge response in the array was observed, discharging over one second with currents of nanoamps. Two types of faster discharges were also seen which lasted a few hundredths of a millisecond and with currents on the order of microamps. Some results indicate an electron emission process associated with the arcs.

9683 **(NE—1983-11) Energy forestry.** Siren, G. (Naemnden foer Energiproduktionsforskning, Stockholm (Sweden)). 1983. 254p. (In Swedish). NTIS (US Sales Only), PC A12/MF A01. File Number DE85750160.

A presentation of the work conducted during 1976-1981 by the energy forest project in Sweden. The goal of the project has been to generate knowledge on theoretical and practical possibilities, to use biomass produced in Sweden, to replace part of the imported oil. The phase of the project now completed comprised work in the following sectors: abrotics, basic biology, experimental application, clonal orchards, experimental stations and administration.

9684 **(NE-FBA—83-19) Research on burning of biomass fuels, KTH.** Hagstroem, U.; Zoukatas, N.; Kutscher, E.; Megas, L. (Naemnden foer Energiproduktionsforskning, Spanga (Sweden)). May 1983. 95p. (In Swedish). NTIS (US Sales Only), PC A05. File Number DE85750173.

The three main principles of combustion, namely burning over the fuel bed, under the bed, and the inverted flame have been investigated. Combustion under the fuel bed rendered the lowest emission of carbon monoxide, hydrocarbons, benzopyrene, particulates and tar. Emission is also reduced by preheating the primary incoming air. Burning of pine gives variable emissions whereas birch tree and lying log gives satisfactory combustion. High flame intensity and Reynolds number of the flame zone in the interval 5 to 8 x 10^3 also give low emission. A conventional wood burner with its flame over the fuel bed and with a water cooled combustion chamber produces 100 times more carbon monoxide than an advanced construction.

9685 **(NE-SBT—83-23) Hasselfors terminal. Investigation of a full-tree terminal integrated with a sawmill.** Eliasson, M. (Naemnden foer Energiproduktionsforskning, Spanga (Sweden)). 1983. 89p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750175.

Taking whole unlimbed stems to a central development creates an interesting provision for the combined production of a competitive sawed raw material with the utilisation of branches, twigs and tops (bratt) as fuel in an economic and efficient manner. Many years of experience of wholestem-system with a stem-processing directly linked to the companys sawmill, combined with a considerable volume produced in the companys own forests, provides a raw material with a relatively long average trunk and short average transport distance, creating good provisions for a full-tree-system. Analysis led to the choice of a main alternative (full-tree) which was projected and costed. This alternative was then compared with other (final cutting) systems on a costs/income basis. The full-tree-method is both economically and technically feasible. This method

also shows favorable results compared to other systems, such as the whole-stem and shortwood. It is possible to state certain basic conditions necessary for a full-tree-system: high proportion of large-dimension forest, normal to high proportion of branches, twigs and tops in the total biomass, a close integration, physically and administratively, with a sawmill in order to exploit the advantages of terminal conversion, good yield in the form of bratt as raw material for fuel. Production costs and the need for a full-scale trial are also discussed.

9686 (ORNL—6085, pp 11-30) **Species screening and genetic selection.** Sep 1984. NTIS, PC AA05/MF A01. File Number DE84017634.

In Short Rotation Woody Crops Program. Annual progress report for 1983.

Species selection was conducted throughout the US for woody species with desirable biomass characteristics. Dr. Don Rockwood recently summarized desirable biomass characteristics in a talk given at the Southern Biomass Research Conference (Rockwood 1983). These include: (1) good growth at relatively low cultural inputs, (2) adaptability to a range of climatic and edaphic variables, (3) high allocation of biomass to main stems rather than foliage and to vegetative growth rather than sexual growth, (4) tolerance to competition, (5) growth patterns that effectively utilize the available growing season, (6) easy and inexpensive propagation, (7) rapid early growth, (8) broad-ranging pest resistance or tolerance, (9) desirable chemical and physical properties for targeted biomass conversion processes, (10) coppicing ability, and (11) nitrogen-fixing ability. Selection of two to six species that have many of the characteristics described above was accomplished for each major region of the US. The collection of new seed sources for biomass species is progressing very rapidly and should provide an excellent genetic base for continued improvement of biomass species. The completion of range-wide seed source collections for five species was identified as a major programmatic accomplishment this year. Collections are ongoing for a number or other species as well.

9687 (ORNL—6085, pp 31-52) **Stand management.** Sep 1984. NTIS, PC AA05/MF A01. File Number DE84017634.

In Short Rotation Woody Crops Program. Annual progress report for 1983.

Achieving the SRWCP objective and goals will require identification of the best stand management procedures for SRIC plantations. Research to data identified procedures for successful establishment and management of SRIC plantations throughout the US. Work on establishment, irrigation, and spacing/rotation length is nearly complete. Additional research is required to advance propagation techniques, evaluate nutrient utilization, quantify risks and losses from pests and diseases, and determine coppice rotation management strategies and productivity. Weed control techniques need further evaluation in some regions and for specific species. In general, the evaluation of stand management procedures was limited to small plantations or experimental plots (less than 10 ha). Actual testing and verification of the best procedures will be delayed until large-scale plantations (greater than 80 ha) are established in several geographic regions. Establishment of large-scale or operational plantations will also be required to quantify productivity rates and costs and, thus, to verify SRWCP goals.

9688 (ORNL—6085, pp 53-64) **Wood-handling equipment and fuel characterization.** Sep 1984. NTIS, PC AA05/MF A01. File Number DE84017634.

In Short Rotation Woody Crops Program. Annual progress report for 1983.

Much more research is needed in conceptualizing and developing harvesting equipment for small diameter trees in closely spaced plantations. Results indicate that harvesting costs can and must be reduced dramatically (perhaps as much as 50%) to bring the short-rotation wood costs in line with other wood and fuel alternatives. Simply stated, harvesting accounts for roughly half the costs of growing and shipping short-rotation materials. It is an ideal area for reducing costs. There now exists a clear set of design criteria for the development of required harvesting equipment. Equipment now under design and development is in need of testing under operational field conditions, especially in coppiced stands where multiple, irregularly shaped, stems may originate from single stumps. More information on wood characteristics is needed for selection and management purposes as SRIC research plots are examined. This year a standardized format is being developed in characterizing wood composition in a manner useful to those handling energy conversion feedstocks and to those who will be working with genetic control and manipulation of these feedstocks. To conduct research properly in controlling wood composition, it will be necessary to determine how some wood substances are formed and allocated within the plant. Specific focus of substance formation during the very early years of growth in noncommercial species will require new research.

9689 (ORNL—6085, pp 65-72) **Economic evaluation.** Sep 1984. NTIS, PC AA05/MF A01. File Number DE84017634.

In Short Rotation Woody Crops Program. Annual progress report for 1983.

Biomass productivity, price costs, and harvesting costs are the key factors to cost-efficient short rotation intense cultivation (SRIC) production. The effects of productivity are clear. The largest reduction in discounted average costs of biomass production will come from gains in productivity research. However, it is recognized that there are diminishing returns to productivity research. Land costs are a large cost item in biomass production. These costs can be minimized by considering the use of lands not currently under intensive production. Site-specific studies will be a major focus in future research activities. Perhaps the most uncertain component of the biomass production system is the cost of harvesting. The ultimate economic viability of SRIC will depend on the success of developing a cost-effective harvesting technology.

9690 (ORNL—6085, pp 73-76) **Plant productivity and site nutrients.** Sep 1984. NTIS, PC AA05/MF A01. File Number DE84017634.

In Short Rotation Woody Crops Program. Annual progress report for 1983.

Loblolly pine, yellow-poplar, sweetgum, and black locust species were established on about 20 ha of nutrient-poor upland sites on the Oak Ridge Reservation that were once used for agriculture and later abandoned due to low productivity. These species are being evaluated for differences in survival and growth, including the causal physiological processes and soil-plant interrelationships, under various combinations of cultural treatments. Treatments included infection of species with appropriate root symbionts (Pisolithus tinctorius, Glomus fasciculatus, and G. mosseae), mulching, and fertilization alternatives. Leaf, stem, and root tissues were sampled for nutrient content (total N, P, K, Ca, and Mg), carbohydrates, lipids, and proteins. Also, water samples were collected after each rainfall from the lysimeters located in each study plot and prepared fors the analysis of several of the major plant nutrients, including NO_3, NH_4, P, and Ca. Chemical analyses of plant tissue and soil water samples provide insight into the mechanisms and pathways of nutrient movement and availability under the intensive management practices required for the optimization of biomass production on marginal lands.

9691 **(SERI/STR—211-2363) Sputtered amorphous silicon solar cells. Final report, 22 July 1982-22 July 1983.** Moustakas, T.D.; Maruska, H.P.; Wronski, C.R. (Exxon Research and Engineering Co., Annandale, NJ (USA)). Sep 1984. Contract AC02-83CH10093. 230p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE84013002.

This document reports on research conducted to further develop reactive sputtering of amorphous silicon solar cell applications. The major goals of the program were to develop intrinsic material capable of generating a short-circuit current density of 12 to 13 mA/cm^2 and an open-circuit voltage of 0.9; to investigate the mechanism of doping of sputtered a-SiH/sub x/ and μc-SiH/sub x/ films and develop methods to dope these layers; to investigate the origin of the low fill factor; to demonstrate a complete p-i-n solar cell structure fabricated totally from silicon targets, without any gas-phase toxic dopants; and to fabricate p-i-n solar cells having efficiencies of 6% or larger. Results showed that the properties of intrinsic and doped sputtered amorphous silicon films can be optimized to produce high-efficiency cells. The photovoltaic properties of the intrinsic films depended on structural and compositional in-

homogeneities, amount of incorporated hydrogen, and low levels of dopant impurities. Amorphous and microcrystalline phosphorus- and boron-doped films were characterized through studies of their optical and transport properties; the superiority of the microcrystalline films for photovoltaic applications has been demonstrated. The 5.5% efficiency obtained with the p-i-n solar cell structures can be improved by depositing the three layers in sequential dedicated chambers and by such design concepts as back reflective contacts and transparent a-SiC front contacts.

9692 **(SERI/STR—211-2409) Advanced high-efficiency concentrator cell. Final report, 1 April 1983-31 March 1984.** Lewis, C.R. (Varian Associates, Inc., Palo Alto, CA (USA)). Oct 1984. Contract AC02-83CH10093. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85000525.

This report presents results of research on novel ways of producing multijunction (cascade) solar cells with overall power conversion efficiencies of ≧ 30%. Recent materials development work permits the individual cells of the cascade to be lattice-mismatched with respect to each other and to the substrate, increasing the number of potentially viable condidate component materials. While initially promising, GaIn P proved to be not as desirable as either GaAs P or AlGaAs, for the upper cell, especially. Two-junction cascade structures were pressed and are described.

9693 **(SERI/STR—211-2471) Thin film gallium arsenide solar cell research. Final report, 1 March-31 August 1982 and 1 May 1983-31 March 1984.** Chu, S.S. (Southern Methodist Univ., Dallas, TX (USA)). Oct 1984. Contract AC02-83CH10093. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000524.

This report contains results of research conducted to produce thin-film gallium arsenide solar cells of 12% conversion efficiency from films 5 to 10 μm thick deposited on low-cost substrates by chemical vapor deposition. Major efforts during this reporting period were directed to the fabrication and characterization of thin-film gallium arsenide solar cells, the fabrication and characterization of gallium aluminum arsenide/gallium arsenide heterojunction solar cells, the preparation of Ge/Si substrates, the recrystallization of germanium films on foreign substrates, and the fabrication and characterization of homojunction solar cells with large-grain gallium arsenide films.

9694 **(SI—1-1984) Energy forest. Foreign experiences - prospects in Denmark.** Heding, N. (Skovteknisk Inst., Copenhagen (Denmark)). 1984. 68p. (In Danish). Skovteknisk Institut, Copenhagen, Denmark. File Number TI85750136.

EFP.

Cultivation of trees for fuelwood or other purposes is done in either of the following four ways: 1. Single trees, i.e., trees planted along roads, in hedges or windbreaks. 2. Forest trees, i.e., trees grown in normal forest stands. 3. Medirotation trees, i.e., trees grown in plantations in 10 to 20 years rotation. 4. Minirotation trees, i.e., trees frown in 2 to 6 years rotations and similar to agricultural crops. Single tree growing is an interesting possibility for Denmark. According to Dutch increment tables poplar road trees will produce from 9 to 24 m^3 solid volume/km/a (single row). By intensive planting of single trees Denmark is likely to be able to double her wood production. It is not considered profitable to further intensify the production of fuelwood. Medirotation trees represent a system that is intermediate between a normal forest crop and a minirotation crop. The rate of increment in French and Canadian poplar coppice stands ranges from between 10 and 17 m^3/ha/a to between 17 and 28 m^3/ha/a. Minirotation trees (energy crops) of 1 to 10 years rotation are considered to be a great production potential. Calculations have demonstrated that the cultivation of trees in minirotation probably cannot complete economically with grain crops on normal agricultural land, cover the cultivation costs on marginal agricultural land, or complete economically with normal forest crops.

9695 **(SLU-IVL—143) Storage of whole-tree chips of different species and in different fractions.** Bjoerklund, L. (Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Virkeslaera). 1983. 59p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750182.

The purpose of this investigation was to study storage of whole-tree chips in piles, particularly the effect of different chip sizes and different tree species. Comparisons were also made with two piles of limbed material. Dry matter loss, moisture content, temperature, basic density and the amount of fungal particles were studied. The chip storage lasted from July 1982 until January 1983. Each of the eight piles contained 55 m^3. Tarpaulin roofs were constructed over the piles. Decreasing chip size and/or the occurence of branch material resulted in increasing pile temperatures. All piles dried during storage. The poorest drying was registered in the pile with limbed spruce, from 48 percent m.c. (m.c. = moisture content, wet basis) to 42 percent m.c. The other piles dried from 40-50 percent m.c. to 25-33 percent m.c. Neither chip sizes nor species seem to have influenced drying to any great extent. The dry matter loss in the three piles with varying chip sizes were almost the same, appr. 8 percent. Pine had a higher dry matter loss, 11.6 percent, than did spruce, 9.4 percent, while birch had the lowest, 6.0 percent. However this might be misleading since many other authors have found that hardwood chips deteriorate quicker than softwood chips. The reason for the result of this investigation could be differences in m.c. at the beginning of storage. The dry matter loss in the piles with limbed material was lower than in the corresponding whole-tree piles. Chip size and tree species seem to have limited influence on the amount of fungal particles.

9696 **(SLU-IVL—144) Study of burning with chipped cleaning residues at a heating plant.** Andersson, Aa.; Thoernqvist, T. (Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Virkeslaera). 1983. 44p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750183.

A fuel assortment for chip burning in the KSS-Ryd heating plant in Skoevde, Sweden has been described for the purpose of studying species composition, fraction size, density and ash content. The chips effective heating value has been calculated for actual average moisture content. In addition the direct and indirect efficiency have been calculated. On an average, the fuel chips moisture content was 46.3 percent and the effective heating value was 16.4 MJ/kg dry matter weight. The direct efficiency was calculated to be 83 percent at an average 75 percent of full load of the heating plant. In the study the indirect efficiency has been calculated at 88 percent, with consideration taken for losses such as smoke gases, radiation, unburned ash, slag and gases. The greatest was smoke gas losses, which were about 10 percent with an air surplus factor of 1.15. A low air surplus often gives an unsatisfactory burn with a high fuel moisture content, the amount of unburned material (ash and klikers) has been analyzed, giving 0.9 percent of the supplied fuel's dry matter weight. Actual measured losses in unburned form in ash, slag and gases was 1.6 percent. A comparison between a oil-fired and fuel chip-fired heating plant shows the materials ability-to-pay calculates to be between 75 and 100 Swedish crowns (USD 9.37 - 12.50) per m^3s, at an oil price of SEK 1,750/m^3 (USD 218.75).

9697 **(SLU-IVL—146) Storage of logging residues which have been reduced into different fractions.** Thoernqvist, T. (Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Virkeslaera). 1983. 32p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750184.

The purpose of this study has been to investigate how different degrees of reduction influence the storage ability of reduced fresh logging residues which are stored in piles. The material was composed of fresh logging residues which were reduced to the three fraction sizes of 5-10 cm, 10-15 cm and 20-30 cm. The fraction size 5-10 cm was reduced in a hammarmill, while the other two fractions were reduced in a Norba coarse crusher. For comparison two additional piles were stored, one with untreated slash and one with mixed spruce and pine bark. Temperature changes, moisture content, and matter loss during storage are discussed.

9698 **(SLU-IVL—150) Change of logging residues during storing at the clear cutting area in two growing seasons.** Thoernqvist, T. (Sveriges Lantbruksuniversitet, Uppsala. Dept. of Forest Products). 1984. 99p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85750186.

9699 **(SLU-IVL—152) Logging residues as a feedstock for energy production. Drying, storing, handling and grading.** Thoernqvist, T. (Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Virkeslaera). 1984. 122p. (In Swedish). Sveriges Lantbruksuniversitet, Institutionen foer Virkeslaera, Uppsala. File Number TI85750187.

The purpose of this thesis is to analyse how certain physical, chemical and biological properties influence the energy content of forest fuels with different handling systems. The thesis is limited in application to logging residues which are collected after clear cutting for energy purposes. The results are applicable to fuel fractions which result from bunch delimbing of whole-tree sections. An analysis of 145 different handling systems shows that the energy content of logging residues changes. From the time the tree is logged until the fuel is at the combustion furnace it varies between + 2 per cent and - 56 per cent. The changes depend on where when and how the logging residues are stored and reduced. After three months storage the energy changes vary between + 2 per cent and - 10 per cent, and after 9 months storage between + 1 per cent and - 31 per cent. The best handling system from the energy standpoint is where the fresh logging residues are transported from the logging area and stored in high piles at the landing or roadside, with subsequent reduction when needed. With this system an increase of a few per cent energy can be obtained. Another system which is just as good is to reduce the fresh logging residues at the logging area and transport the material in containers for direct user combustion. It is not suitable to store reduced logging residues longer than a couple of months.

9700 **(TRITA-FYK—8201) Dynamics of solid/gas processes for energy conversion.** (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Fysikalisk Kemi). 1982. 75p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85750178.

The report summarises the proceedings of a workshop colloquium on the dynamics of thermochemical energy storage. The topics covered energy storing absorption heat pumps, hydride heat-pump reactors and metals for thermal energy conversion systems.

1406 Photovoltaic Power Systems

9701 **(EFN-TEKNIK—83/6) Solar cells on buildings. Progress report.** Engstroem, L.; Rydberg, S. (Energiforskningsnaemnden, Stockholm (Sweden)). Feb 1983. 101p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750180.

An estimation of the possible production of electric power by solar cells on existing buildings by the year 2000 is presented. Suitable roof areas for the installation of solar cells are calculated to be 160 Mm^2. Based on climatic data of the year 1971, the solar radiations calculated at 1000 kWh per m^2 and year. The efficiency of the cells being 20 percent, then the potential of produced electric power of about 32 TWh per year can be expected. The real potential is dependent on the possibilities to amount to 5 TWh per year, to be stored in hydro power reservoirs.

9702 **(N—84-29332) Preliminary concept of a 100-kilowatt miniaturized Cassegrainian concentrator solar array.** Patterson, R.E. (TRW Space Technology Labs., Redondo Beach, CA (USA)). 1984. 6p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 157-162, N—84-29307 19-44.

A miniaturized Cassegrainian concentrator (MCC) solar array system is examined to assess the practicality of assembling the basic MCC element into a total array system capable of producing multi-hundred kilowatts of power for Space Platform/Space Station or other low Earth orbit long lifetime missions. Preliminary mechanical and electrical subsystems are developed in order to determine first order performance characteristics. Results of the study support the feasibility of a 100-kilowatt MCC array system with beginning-of-life (BOL) performance of 160 watts per square meter and 28 W/kg. The performance numbers are based on 20 percent efficient (at operating temperature) solar cells and 0.25-millimeter thick electroformed nickel optics. These performance numbers can be improved upon significantly with the development of higher efficiency solar cells and/or lighter weight optics.

9703 **(N—84-29333) Performance measurement of low concentration ratio solar array for space application.** Mills, M.W. (Rockwell International Corp., Los Angeles, CA (USA)). 1984. 13p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 163-175, N—84-29307 19-44.

The measured performance of a silicon and a gallium arsenide low concentration ratio solar array (LCRSA) element is presented. The element characteristics measured in natural sunlight are off pointing performance and response to mechanical distortions. Laboratory measurements of individual silicon and gallium-arsenide solar cell assemblies are also made. The characteristics measured in the laboratory involved responses to temperature and intensity variations as well as to the application of reverse bias potentials. The element design details covered include the materials, the solar cells, and the rationale for selecting these specific characteristics. The measured performance characteristics are contrasted with the predicted values for both laboratory testing and high altitude natural sunlight testing. Excellent agreement between analytical predictions and measured performance is observed.

9704 **(N—84-29334) Preflight study of San Marco D/L GaAs solar cell panels.** Day, J.H. Jr. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). 1984. 6p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 176-181, N—84-29307 19-44.

The solar array for the San Marco D/L spacecraft is described and the performance of 4 GaAs solar cell panels are examined. In comparison to the typical Si solar cell panel for San Marco D/L, it is shown that each GaAs solar cell panel provides at least 23 percent more specific power at maximum output and 28 deg C. Also described here, are several measurements that will be made to evaluate the relative performance of Si and GaAs solar cell panels during the San Marco D/L flight.

9705 **(N—84-29335) Preliminary space station solar array structural design study.** Dorsey, J.T.; Bush, H.G.; Mikulas, M.M. Jr. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). 1984. 11p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 182-192, N—84-29307 19-44.

Structurally efficient ways to support the large solar arrays (3,716 square meters which are currently considered for space station use) are examined. An erectable truss concept is presented for the on orbit construction of winged solar arrays. The means for future growth, maintenance, and repair are integrally designed into this concept. Results from parametric studies, which highlight the physical and structural differences between various configuration options are presented. Consideration is given to both solar blanket and hard panel arrays.

9706 **(N—84-29336) Development and support structures for high-power solar arrays.** Knapp, K. (Astro Research Corp., Santa Barbara, CA (USA)). 1984. 12p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 193-204, N—84-29307 19-44.

A number of structurally efficient configurations for wing-type solar arrays are developed by a combination of deepening the planform of the blanket and structure and by partitioning the blanket with battens and frequent attachments to the support structure. This technique reduces the tension required to avoid a low natural frequency for the blanket, and the load reduction results in a lighter structure. The use of three different structures are investigated: the Astromast, the Extendible Support Structure (ESS), and a new beam called the STACBEAM (Stacking Triangular Articulated Compact Beam) and their relative performances are compared. The investigation of the STACBEAM is emphasized because its sequential deployment is more reliable for very long systems, and its linear deployment facilitates local attachments to the blanket and the development of a low mass deployer.

9707 **(N—84-29337) Panel fabrication utilizing GaAs solar cells.** Mardesich, N. (Spectrolab, Inc., Sylmar, CA (USA)). 1984. 5p. NTIS, PC A12/MF A01.

In NASA, Lewis Research Center, Space Photovoltaic Research and Technology, 1983, 205-209, N—84-29307 19-44.

The development of the GaAs solar cells for space applications is described. The activities in the fabrication of GaAs solar panels are outlined. Panels were fabricated while introducing improved quality control, soldering laydown and testing procedures. These panels include LIPS II, San Marco Satellite, and a low concentration panel for Rockwells' evaluation. The panels and their present status are discussed.

9708 **(N—84-29343) Solar array: plasma interactions.** Purvis, C.K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 1p. NTIS, PC A12/MF A01.

In Space Photovoltaic Research and Technology, 1983, 236, N—84-29307 19-44.

Interactions between space systems and their orbital particle and field environments have significant impact on the system's operation and life. Interactions such as radiation damage and aerodynamic drag are considered in designing space systems. There are, however, a number of orbital environmental interactions which become important design considerations only for large or high power systems. Their impact is assessed to ensure successful design. Interactions between higher voltage solar arrays and the space plasma which are of critical concern in designing large orbital photovoltaic power systems are outlined.

9709 **(N—84-29349) Synthesis of major economic studies of residential photovoltaics. Final Report.** (Jet Propulsion Lab., Pasadena, CA (USA)). Apr 1984. 32p. (NASA-CR—173766). NTIS, PC A03/MF A01.

Six studies that analyze the cost effectiveness of grid connected residential photovoltaic systems are reviewed. These six studies were selected based on two criteria. First, the reports share common emphases on developing photovoltaic systems with certain engineering design goals in mind, and on performing economic analyses to assess the long term economic potential of the system design. The economic analyses presented are performed from the consumer's perspective.

9710 **(N—84-30529) Multi-100kW: planar low cost solar array development. Final Report.** (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA (USA)). Jul 1984. 62p. (NASA-CR—171119). NTIS, PC A04/MF A01.

Seven low cost multi-100 kW planar solar array modules were fabricated and tested. Two different designs were used, demonstrating advanced solar array construction practices. Both module types utilized second generation gridded back cells featuring high efficiency and IR transparency. A silicon dioxide AR coating optimized for transmission at gamma 1.7 microns was applied to the back surface. Two interconnect types, a single sheet printed circuit and a roll type, with alternate approaches to increasing transparency and reducing cost were designed and fabricated. Hinge stress and electrical power optimization were also examined. Two point designs were studied. The first design used a coilage longeron mast and is autonomously deployable. The second design used a Stac Beam for high natural frequency response and required astronaut assistance and assembly on orbit. It was conclusively demonstrated that planar arrays are the most cost effective design for use on the space station or other high power applications.

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9711 **(DOE/DR/00789—T100) SSPS monthly data, July 1984: plant operation report and daily operation summary.** (Compania Sevillana de Electricidad, S.A., Madrid (Spain)). 1984. Contract AC04-76DR00789. 91p. NTIS MF A01; 2; GPO Dep. File Number DE85004420.

Operation and maintenance highlights, tests performed, and plant statistics are given for both central receiver and distributed collector systems for the month of July, 1984. Monthly operation data are summarized, including meteorological and performance data. Daily plant operation reports are given for both systems for each day in July, 1984, including meteorological data, heliostat and collector field operation, energy storage, power generation, and data acquisition system operation. (LEW)

9712 **(DTH-LV-MEDD—143) International Energy Agency solar heating and cooling programme. Task 8. Passive and hybrid solar low energy buildings. Analysis model survey.** Joergensen, O. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Dec 1983. 187p. NTIS (US Sales Only), MF A01. File Number DE85750150.

Subtask B, Modelling and Simulation, is one of several subtasks of Task 8, Passive and Hybrid Solar Low Energy Buildings of the IEA Solar Heating and Cooling Programme. One of the objectives of this subtask is to evaluate current analysis models for passive and hybrid systems in the member countries. This report documents the first step of this evaluation process, namely a survey of the models that are available, as well as their analysis capabilities and limitations. The reader is provided with a full set of completed survey forms and five summary tables to assist in the selection on an appropriate model for a specific problem.

9713 **Analysis and design of the Solar One thermal storage subsystem heat exchangers.** Weiner, F.R. (Rockwell International Corp., Canoga Park, CA). *Journal of Solar Energy Engineering;* **106**: 279-285(Aug 1984).

This paper describes the analysis and design of the five kinds of heat exchangers used in the thermal storage subsystem of the 10 MWe Solar Central Receiver Pilot Plant, now becoming more known as Solar One. The paper discusses the practices and standards used in the designs of the heat exchangers, lists the heat exchanger design requirements, and discusses the process conditions. The design assumptions and constraints, the geometrical considerations, and the tradeoff studies that were conducted to optimize the designs are also discussed. A description of each heat exchanger reveals the final design solution. Novel and unique features of a power plant that must operate on a daily sun-cycle are identified. 7 references.

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9714 **(PB—84-238815) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea test. Volume 1. Statistical data for selected discs (Part 1).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 172p. NTIS, PC A08/MF A01.

See also PB84-238823.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9715 **(PB—84-238823) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 1. Statistical data for selected discs (Part 2).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 148p. NTIS, PC A07/MF A01.

See also PB84-238831.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms

used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9716 **(PB—84-238831) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 1. Additional statistical data for selected discs (Part 1).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 30 Dec 1983. 163p. NTIS, PC A08/MF A01.

See also PB84-238849.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9717 **(PB—84-238849) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 1. Additional statistical data for selected discs (Part 2).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 30 Dec 1983. 148p. NTIS, PC A07/MF A01.

See also PB84-238831.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9718 **(PB—84-238856) NOAA OTEC CWP (National Oceanic and Atmospherc Adminstration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 2. Plots of the power spectra for selected channels (Part 1).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 253p. NTIS, PC A12/MF A01.

See also PB84-238864.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9719 **(PB—84-238864) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 2. Plots of the power spectra for selected channels (Part 2).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 297p. NTIS, PC A13/MF A01.

See also PB84-238872.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9720 **(PB—84-238872) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 2. Plots of the power spectra for selected channels (Part 3).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 363p. NTIS, PC A16/MF A01.

See also PB84-238880.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9721 **(PB—84-238880) NOAA OTEC CWP (National Oceanic and Atmospheric Adminstration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 2. Plots of the power spectra for selected channels (Part 4).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 231p. NTIS, PC A11/MF A01.

See also PB84-238898.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS,

maximum, and minimum values at each depth are shown in each plot.

9722 **(PB—84-238898) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 2. Plots of the power spectra for selected channels (Part 5).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 341p. NTIS, PC A15/MF A01.

See also PB84-238906.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9723 **(PB—84-238906) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 2. Plots of the power spectra for selected channels (Part 6).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 209p. NTIS, PC A10/MF A01.

See also PB84-238898.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9724 **(PB—84-238914) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 2. Additional plots of the power spectra for selected channels (Part 1).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 30 Dec 1983. 405p. NTIS, PC A18/MF A01.

See also PB84-238922.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9725 **(PB—84-238922) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 2. Additonal plots of the power spectra for selected channels (Part 2).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 30 Dec 1983. 493p. NTIS, PC A21/MF A01.

See also PB84-238930.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9726 **(PB—84-238930) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 2. Additional plots of the power spectra for selected channels (Part 3).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 30 Dec 1983. 494p. NTIS, PC A21/MF A01.

See also PB84-238948.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9727 **(PB—84-238948) NOAA OTEC CWP (National Oceanic and Atmospheric Administraton Ocean Thermal Energy Converson Cold Water Pipe) At-Sea Test. Volume 2. Additional plots of the power spectra for selected channels (Part 4).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 30 Dec 1983. 252p. NTIS, PC A12/MF A01.

See also PB84-238930.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9728 **(PB—84-238963) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 3. Tabulation of the power spectra for selected channels (Part 2).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 244p. NTIS, PC A11/MF A01.

See also PB84-238971.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9729 **(PB—84-238971) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 3. Tabulation of the power spectra for selected channels (Part 3).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 226p. NTIS, PC A11/MF A01.

See also PB84-238989.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9730 **(PB—84-238989) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 3. Additional tabulation of the power spectra for selected channels (Part 1).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 30 Dec 1983. 353p. NTIS, PC A16/MF A01.

See also PB84-238997.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9731 **(PB—84-239003) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 4. Time histories of selected channels (Part 1).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 297p. NTIS, PC A13/MF A01.

See also PB84-239011.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9732 **(PB—84-239011) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 4. Time histories of selected channels (Part 2).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 321p. NTIS, PC A14/MF A01.

See also PB84-239029.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9733 **(PB—84-239029) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 4. Time histories of selected channels (Part 3).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 297p. NTIS, PC A13/MF A01.

See also PB84-239037.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9734 **(PB—84-239037) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 4. Additional time histories of selected channels (Part 1).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 30 Dec 1983. 489p. NTIS, PC A21/MF A01.

See also PB84-239045.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

9735 **(PB—84-239045) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) At-Sea Test. Volume 5. Additional plots of bending strain along the pipe.** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 30 Dec 1983. 46p. NTIS, PC A03/MF A01.

See also PB84-239037.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 1409009712

9736 **(DOE/CS/30555—T1) Installation of solar energy systems: training community college faculty. Final report.** (League for Innovation in the Community Coll., Dallas, TX (USA)). Dec 1981. Contract FG01-80CS30555. 93p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85005212.

The overall strategy of the project was to train a minimum of 240 community college and vocational/technical faculty from 120 institutions in 8 workshops during a one-year period. An average of thirty participants attended each five-day workshop which focused on substantive, solar energy content, demonstrations and hands-on activities which were developed in the pilot project. Upon completion of each five-day workshop, the participants were given assignments which will be utilized in long and short term training sessions at their home institutions. Participants have remained in contact with the workshop peer instructors and project staff, thus developing a linking network. In addition, the League will strengthen this network through the continued distribution of relevant information on solar energy for curricular development and other uses. Participants received, upon completion of training, technical assistance from project staff and resource personnel to establish installer training programs at their institutions. In addition, each institution was provided with instructional aids basic for an installer training program.

9737 **(DOE/ER/12089—1) Experimental research in high temperature solar thermochemical processing hydrogen and sulfur from hydrogen sulfide. Final report.** Fletcher, E.A.; Diver, R.B.; Kappauf, T.; Murray, J.; Palumbo, R. (Minnesota Univ., Minneapolis (USA). Dept. of Mechanical Engineering). Oct 1984. Contract AC02-82ER12089. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85004091.

The solar thermochemical production of hydrogen and sulfur from hydrogen sulfide was studied, using a 4.2 meter solar furnace as a source of process heat. Two different reactor configurations were used. The principal independent variables were temperature and feed rate. A secondary independent variable was the pressure. The dependent variables measured were the hydrogen production rate, the yield, and the quench fraction (fractional yield). High yields, of the order 0.5, and quench fractions, of the order 0.7, were observed over a respectable range of temperatures and feed rates. Yields were a monotonically increasing, almost linear, function of the temperature. The experimental observations are rationalized by a kinetic model that concludes that gas phase reaction rates are probably too low to account for the high yields observed; a good reactor should embody the heating of the feed stream in contact with a surface to facilitate decomposition of the hydrogen sulfide, and the quench of the product stream should be accomplished in such a way as to cool it while minimizing surface reactions. The reactors are described. Mullite, alumina, Fiberfrax, and zirconia all seem to be suitable materials of construction from a chemical standpoint, but mullite experienced some apparent sintering, deformation and thinning in the hottest parts of the reactor, where it may have been exposed to high temperature excursions, and some damage, apparently due to thermal stress, where it came in contact with a separator. An economic evaluation of a plant for producing hydrogen and sulfur from hydrogen sulfide suggests that the process could be economically viable, especially if the cost of electric power and other alternative energy sources becomes high.

9738 **(DOE/R5/10300—T2) [Recycling conventional greenhouse parts into a passive solar unit]. Final technical report.** (Indiana Univ. East, Richmond (USA)). 1984. Contract FG02-81R510300. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003926.

The purpose of this grant was to recycle parts from a conventional greenhouse and use as many of them as possible to construct a passive solar greenhouse that would be used as a demonstration and research unit for the efficiency of passive solar energy. The original proposal projected 75% efficiency of the passive solar system for this region of the country (central Indiana). It was projected that no supplementary heat would be needed if an outside mean temperature of 30.5°F were maintained. This figure was based on an estimated 70% cloud cover during December to February for our region. The original proposal recommended only heating the areas of the planting beds if auxillary heat was needed. Heat data were to be collected on a chart recorder using termistors placed in a variety of locations. This apparatus recorded outside and two inside temperatures plus indicated when the auxillary heat turned on and off. Data were to be analyzed by a computerized system which interfaced with the temperature recorded. Information about the greenhouse and its effectiveness was to be disseminated to the general public. Plans were made to compare the data from the passive solar unit to an active solar system of comparable size located at Hayes Arboretum in Richmond, Indiana. Finally, the greenhouse would provide a teaching resource for the university.

9739 **(DOE/SF/10565—T1) Passive solar design manual for San Diego County.** (San Diego, County of, CA (USA)). 1 Mar 1982. Contract FG03-79SF10565. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85004484.

Some of the information is provided that is needed to successfully incorporate passive solar design features in new residential buildings in San Diego County. Some of the information is also applicable to retrofit situations. Each passive concept is described separately and its impact on conventional energy requirements is presented. A method is also provided for estimating the energy use effects of incorporating pasive design elements in a residential building, either singly or in combination with other elements. (LEW)

9740 **(DTH-LV-MEDD—124) Solar heating through windows. Some simple design rules for ordinary houses.** Mejlhede Jensen, N. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Nov 1982. 30p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750126.

Houses built in Denmark are, with a few exceptions, not planned to benefit from passive solar energy. In many cases it would be possible to save 20-30% of the energy for domestic heating for a normal house simply by arranging the windows with respect to the sunshine. This paper gives on a few pages the rough background for designing a "normal" dwelling in Denmark with respect to passive solar energy. The method described in this work is in particular useful for the preiminary design of a house. More accurate projection will require modelling using a computer program.

9741 **(DTH-LV-MEDD—132) Economic contributions from the sun for heating domestic hot water.** Pedersen, S.; Furbo, S.; Nordgaard Hansen, P.; Ussing, V. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Dec 1982. 34p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750139.

EFP-80.

In this report economic contributions from the sun for heating domestic hot water has been analyzed by "the present-value method". The yield of the solar systems is estimated by computer programmes developed by "The Thermal Insulation Laboratory" of "The Technical University of Denmark". Systems applicable for existing housing as well as systems applicable for new houses have been studied. The most important conclusions are: The price level of solar systems for existing houses is at present some what too high to have solar heat improve the economy of the installation, when comparing with systems based on flow water heaters. The price of solar systems must be reduced by 30% for a 2-3 m^2 solar system (optimal size) in order to make it an attractive alternative. Such a price reduction is not unrealistic for the small solar systems which can be expected on the Danish market in the immediate years, thus making solar systems attractive, even when the present government subsidies expire. By installation of solar systems in new houses the additional expense for installing the solar system is small. Under these circumstances investment in solar heating will give a better interest than an investment in a system consisting only of a flow water heater.

9742 **(DTH-LV-MEDD—138) Perspectives on solar heat today and in the future.** Ellehauge, K.; Oestergaard Jensen, S. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Jan 1984. 42p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750130.

A description is given of the present solar heating technology, and the future role of solar heating in the Danish energy supply system is evaluated. The evaluation of the future role of solar heating is based on the technical and economic development up till now and on the developments that already today can be seen. It is concluded that solar heating in the next 50 years may become a rather big supplement to the total Danish energy supplies.

9743 **(DTH-LV-MEDD—145) Solar home in Birkeroed. Calculations and measurements.** Mejlhede Jensen, N. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Dec 1983. 79p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750132.

A low-energy house with south-facing windows has been found of interest for calculations and measurements of temperatures and energy consumption. the house is a two-story one-family house with electric heating. The total floor area is 200 m^2. It is inhabited by a family of two. In a normal year the house has a calculated total heat loss of 9,500 kWh for an indoor temperature of 17degC and 12,000 kWh for an indoor temperature of 20degC. The heat supply from passive solar energy through windows is calculated to 2,500 kWh/year and free heat from persons and electric lighting. is calculated to 2,000 kWh/year. So the heat requirement for space heating is 5,000 kWh/year (by 17degC) or 7,500 kWh/year (by 20degC). This corresponds well with measurements in 1982 and 1983. On sunny days there can be a temperature increase of 3degC in the ground floor area (light weight concrete constructions) and of 15degC in the upper floor area (constructions of wood and gypsum board).

9744 **(DTH-LV-MEDD—146) Solar heating system for domestic water heating in Gl-Holte. Evaluation of one year measurements.** Melson, S. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Jan 1984. 69p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750131.

This report contains the results from one year of measuring on a small solar system for domestic hot water. The system has been installed in an existing single family dwelling in Gl-Holte which is a suburb north of Copenhagen. The solar collector is 4.71 m^2 with one layer of glass and selective coating on the absorber plate. The storage is a water tank containing 300 litres. The system has been operating very well for the whole period. The thermal performance is measured to be 320 kWh/m^2 solar collector. The solar fraction of the domestic hot water has been 69%. The system has been dimensioned for a domestic hot water consumption of 200 litres per day while the actual consumption has been 140 litres per day. For a load of 200 litres per day and with weather data from the Danish test reference year the thermal performance would have been 410 kWh/m^2/year with a solar fraction of 62%. The energy saving consisting both of the solar used and the no-load loss from the oilburner in the summer months would be 337 litres oil per year. In the report is also described two experiments on the laboratory, one with a solar system containing a immersion heater at the top of the storage and one with a solar system using a storage of only 150 litres. Neither the immersion heater nor the small storage seem to have had any significant influence on the thermal performance of the system.

9745 **(DTH-LV-MEDD—148) Types and sizes of heat storages for solar heating systems for domestic hot water heating.** Oestergaard Jensen, S.; Furbo, S. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Mar 1984. 85p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750153.

The suitability of the different heat storage types available on the market to-day for solar heating systems for domestic hot water sypply has been investigated. The investigations were based on considerations concerning the thermal performance as well as economical considerations. The rules-of-thumb concerning the economically best heat storage volume and solar collector area for solar heating systems for domestic hot water supply have been established. These rules are based on the quantity of the daily water consumption. The influence of the consumption pattern on the economically best heat storage has been elucidated. Finally calculations concerning the economical conditions for solar heating systems for domestic hot water supply have been carried out.

9746 **(NBSIR—84-2972) Multi-year plan for Experimental Systems Research - passive and hybrid solar energy program.** Greenberg, J. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Nov 1984. Contract AI01-76PR06010. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004698.

This report addresses the development of a multi-year plan for Experimental Systems Research focused at gaining the necessary knowledge to advance the understanding of passive and hybrid solar energy technology. This understanding includes the ability to acquire building performance data under controlled conditions so that the fundamental mechanism of the driving forces that effect change, along with the resulting change, can be studied. This information is basic for algorithm development defining relationships between the various physical elements which interact within a building and also in determining the accuracy of the various models and simulations developed for use in heating and cooling applications. Specifically, the report covers the comprehensive planning effort undertaken to achieve a consensus regarding the research to be performed, the most appropriate facility to perform the research, and the funding requirements. It includes the process whereby through a series of working meetings and exchange of correspondence, a list of candidate research areas were identified for both heating and cooling technologies. These report articulates the results of this

effort and details the recommended Experimental Systems Research Activities for solar passive and hybrid technologies for FY85 and beyond.

9747 **(NBSIR—84-2980) Research priorities for improving the effectiveness of active solar hot water and space conditioning systems.** Dikkers, R.D.; Kennish, W.J.; Winn, C.B.; Huston, W. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Dec 1984. Contract AI01-76PR06010. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85005227.

As part of the FY 1983 Department of Energy Systems Effectiveness Research Program, the National Bureau of Standards (NBS) was assigned responsibility for developing research priorities for improving the effectiveness (i.e., thermal performance, cost, reliability and maintainability) of active solar hot water and space conditioning systems. To carry out this task, NBS, in cooperation with various industry representatives, organized and conducted two meetings in August 1983. The first meeting covered all major aspects of active solar hot water and space conditioning systems. The second meeting dealt only with solar control subsystems. Based on information obtained from these meetings, recommended research priorities for improving the effectiveness of active solar energy systems are presented.

9748 **(SAND—84-0237) Total normal emittance measurements of highly conductive, opaque materials using a solar furnace.** Marshall, B.W. Jr.; Mulholland, G.P.; Edgar, R.M. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1984. Contract AC04-76DP00789. 69p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004855.

This report presents a method for measuring the total normal emittance of a conductive opaque material with and without a selective surface coating and at elevated temperatures. The purpose was to develop a method for measuring surface properties of materials subjected to highly concentrated solar flux. A horizontal axis solar furnace was used to heat the samples to temperatures ranging from 373 to 973 K (100° to 700°C), with all tests conducted in air. A Kendell MK-VI radiometer consisting of a cavity-type radiometer and a control unit was used to measure the total normal emittance. The emittance measurements for both copper and aluminum at 373 and 473 K (100° and 200°C) were found to be unreliable because of relatively high drift in the cavity-type radiometer system compared to the emitted energy at these temperatures. However, total normal emittance measurements of these materials at 573 K (300°C) and above compare favorably with trends of published data. A Kline-McClintock uncertainty analysis was performed with experimental uncertainties of +-10% to 15% of the emittance value obtained.

1410 Solar Collectors And Concentrators

9749 **(ANL—82-81) Side-by-side comparisons of evacuated compound parabolic concentrator and flat plate solar collector systems.** McGarity, A.E.; Allen, J.W.; Schertz, W.W. (Argonne National Lab., IL (USA)). Oct 1983. Contract W-31-109-ENG-38. 76p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85004833.

Three liquid-based solar heating systems employing different types of solar collectors were tested side by side near Chicago, Illinois for one year. The three different types of collectors were: a flat plate collector with a black-chrome coated absorber plate and one low-iron glass cover; an evacuated-tube compound parabolic concentrator (CPC) with a concentration ratio of 1.1, oriented with tubes and troughs along a north-south axis; and an evacuated-tube CPC collector with a concentration ratio of 1.3 and one low-iron glass cover, with tubes and troughs oriented along an east-west axis. Results indicate that the flat plate collector system was the most efficient during warm weather, but the CPC systems were more efficient during cold weather, but the CPC systems were more efficient during cold weather, and the CPC systems operated under conditions too adverse for the flat plate collector. The computer simulation model ANSIM was validated by means of the side-by-side tests. The model uses analytical solutions to the storage energy balance. ANSIM is compared with the general simulation TRNSYS. (LEW)

9750 **(BFR-R—84-1983) District heating test rig in Soedertoern (Sweden). A description of the rig and experience of commissioning.** Karlsson, N.-G.; Haakansson, R.; Zinko, H. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 137p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. File Number DE85750156.

The Soedertoern district heating test rig has been built as part of the work on a larger solar district heating project being carried out jointly by the Swedish District Heating Association, SISOL (Swedish Industries Solar Energy Association) and the Swedish State Power Board, with the objective of obtaining practical operating experience of large-scale solar energy utilization in existing district heating systems. For the present trials, a total of about 1000 m^2 of solar collector surface area has been installed, supplied by six different manufacturers. Three collectors are of the flat plate type with a selective coating, one is a flat plate type with selective coating and a cover of evacuated glass tubes, and the remaining two are of vacuum tube types. Trials were started in March 1982, and it is intended that they will continue in order to obtain data and assess results until and including the 1984 operating season. This report is an interim report, describing the technical design of the equipment and giving details of practical experience of initial design, erection and operation up to September 1982.

9751 **(BFR-R—85-1983) Flat-plate thermal solar collectors. Development of methods of testing for ageing and corrosion behaviour.** Wennerholm, H. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 75p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750157.

The overall objective of this project is to develop accelerated methods of testing the materials used in flat-plate thermal solar collectors. The extent of the problem has been limited to the absorber material. The aim is to develop two or three methods of testing, capable of revealing any weaknesses in all types of absorber surface. The following primary causes of breakdown have been identified, using the methods described in ANSI/ASTM E 632-78: high temperature, temperature cycling, ultra-violet radiation, moisture and air pollution. Combinations of these are often used during testing. Some of the results obtained from test work are as follows: The majority of paints could not withstand temperatures above 200 degrees C. Black chrome withstood 250 degrees C. Stainless selective absorbers withstood all tests. Enamel on steel withstood all tests. Painted steel and aluminium absorbers are often sensitive to temperature cycling and high relative humidities. As the test results have not yet been compared with absorbers exposed under outdoor conditions, it is not yet possible to use the results to assess absorber life lengths.

9752 **(DOE/CS/15071—T1) Development and commercialization of low cost, nonmetallic solar system. Final report.** (Solex Corp., Lowell, MA (USA)). 1984. Contract FG01-81CS15071. 18p. NTIS, PC A02. File Number DE85004288.

The project goal was to develop and commercialize a low cost non-metallic flat plate solar collector made from a synthetic rubber called ethylene-propylene-diene-monomer (EPDM). To insure a reliable product, a considerabe portion of the development effort centered around economical manufacture by mechanized processes.

9753 **(SP-RAPP—1983-41) Durability and reliability of solar collectors.** Lagerkvist, K.O.; Wennerholm, H. (Statens Provningsanstalt, Boraes (Sweden)). 1983. 150p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. File Number DE85750179.

From 1981 to 1983 15 solar heating plants have been inspected in order to identify failures and problems. Most of the plants have been used for heating tap water and the heater medium has been a mixture of water and glycol. The size of the solar collectors was 8 to 3000 m^2. Some of the newer plants had damages because of empty and uncooled collectors which caused high temperatures and fast temperature changes. Condensation caused considerable corrosion. Poor installation and control brought along unneccessary failures.

1420 Heat Storage

REFER ALSO TO CITATION(S) 1420009745, 9947, 9948

9754 (DTH-LV-MEDD—126) Test methods for small heat storage systems and testing experience. Furbo, S.; Larsen, J.E. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Nov 1982. 69p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750129. EFP-80. 11 refs.

Test facilities for heat storages for solar heating systems for domestic hot water supply have been constructed. Test procedures for the heat storages have been developed. The test procedures have been used to test heat storages marketed in Denmark. Experiences concerning the test procedures and different constructions of heat storages have been gained. The test facilities and test procedures are described. The following characteristics for each heat storage are measured/investigated: 1) the thermal loss coefficient during a period with the solar collector in operation, 2) the thermal loss coefficient during a period without solar collector operation, 3) the heat storage capacity, 4) the heat transfer power per deg C temperature difference between the solar collector fluid and the heat storage for different storage temperatures, 5) the pressure drop across the heat storage for different solar collector fluid volume flows, and 6) the dynamic behaviour of the heat storage. The results of one of the tested heat storages are given. Further the experience concerning the test procedures and the design of heat storages gained during the tests are described.

9755 (DTH-LV-MEDD—147) Unit for local storage of solar gain. Final report. Paludan-Mueller, C. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Jan 1984. 129p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85750147.

The aim of this project has been to develop a unit for storing a considerable amount of the surplus heat due to solar gain in rooms with large windows facing south and with a low heat capacity. The heat accumulating unit is placed "locally", i.e., inside the room in question, which in this case means the living room in a single-family dwelling. In order to obtain a compact design of the unit, it is essential to use a storage medium with a large heat content per unit volume within the interval where the room temperature varies. In this project a mixture of $CaCl_2$ and water has been chosen as phase change material. Two units were installed in a test house and tested under realistic conditions. A model of the heat transfer to and from the unit was preparted for a computer program and the dependence of the enegy savings on different parameters was investigated by calculations. It was decided to construct a third storage unit with a better heat transfer coefficient from the room air into the storage than the two units used for the realistic testing. The heat transfer coefficient was measured at the laboratory. Finally an examination of the economical benefits of local storage unit was carried out.

9756 (DTH-LV-MEDD—149) Testing of chemical heat pump storage. Dyrnum, O. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Apr 1984. 72p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750154.

The purpose of the exercise is to develop a chemical heat storage which is economically and suitable to use in connection with solar energy. The system in question works as an absorption heat pump utilizing sodium sulphide as absorbent and heat storage medium and water as the working medium. This involves the reversible process $Na_2S + 41/2H_2O <-> Na_2S{:}41/2H_2O + 15.75$ kJ/mol where heat is produced during the absorption and heat is consumed during the desorption process. The first part of the report is dealing with the thermodynamic background for the process and expressions for equilibria, temperature rises and heat of reactions are evolved and a qualitative description of the absorption and desorption process is given. Secondly, the apparatus used for the experiments is described and so are the experiments carried out. During the experiments 80% of the theoretical storage density was obtained. The loadings were carried out at 80degC and lasted for 180 hours, and at a temperature of 50degC the unloadings lasted for between 50 and 150 hours, depending on the rate of heat extraction. The chemical heat storages seems promising, but must be simplified, possibly by using liquid absorbents.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

9757 (LA—10209-MS) Evaluation of the St. Lucia geothermal resource: engineering investigation and cost estimate. Altseimer, J.H.; Edeskuty, F.J.; Taylor, W.B.; Williamson, K.D. Jr. (Los Alamos National Lab., NM (USA)). Aug 1984. Contract W-7405-ENG-36. 52p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85005228.

An engineering and economic study of the development of geothermal energy in St. Lucia has given cost estimates for electricity and process heat produced from the geothermal energy, identified additional industries that are worthy of further examination, and developed methods for examining the economic impact of this new energy source. Costs have been estimated for electricity produced from geothermal energy, by diesel engines used only during peak power demand, by diesel engines producing the total electricity requirement, by an oil-fired steam-power plant, and by a coal-fired steam-power plant. Costs have also been estimated for thermal energy to be used for industrial process heat under various conditions of transport distances, capacity factors, and temperature requirements. Several industries that may be attracted to St. Lucia by the development of geothermal energy have been identified.

1502 Geology And Hydrology Of Geothermal Systems

9758 (LA—10234-MS) Evaluation of the St. Lucia geothermal resource: geologic, geophysical, and hydrogeochemical investigations. Ander, M.; Goff, F.; Hanold, B.; Heiken, G.; Vuataz, F.; Wohletz, K. (Los Alamos National Lab., NM (USA)). Aug 1984. Contract W-7405-ENG-36. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85005231.

Separate abstracts were prepared for three papers. (MHR)

9759 (LA—10234-MS, pp 3-42) Geologic evaluation of the Qualibou caldera geothermal resource, St. Lucia, West Indies. Wohletz, K.; Heiken, G. Aug 1984. NTIS, PC A05/MF A01. File Number DE85005231.

In Evaluation of the St. Lucia geothermal resource: geologic, geophysical, and hydrogeochemical investigations.

St. Lucia is a volcanic island of the Lesser Antilles arc. Much of the southern portion of the island is dominated by mountainous landscape that, along with steam fumaroles and boiling pools near the town of Soufriere, attests to its volcanic origin. The major event in this volcanic field was eruption of the Choiseul Pumice and formation of the Qualibou caldera (32,000 to 39,000 years ago). The latest magmatic activity within the caldera was the eruption of large dacitic domes and associated tephra at Belfond (20,000 to 32,000 years ago). Two major NE-SW-trending faults straddle the caldera; they cross St. Lucia and are parallel to small graben-forming faults. Caldera faults are best developed in northern sections of the caldera; they define an arcuate western caldera margin, whereas those of the southern margin are crescent shaped and form a scalloped caldera margin, affected by regional fault trends. Faulting and hydrology have controlled the location of thermal springs. Regional linear faults and caldera faults are the most important in providing pathways to the surface for thermal waters originating at depth. A complex, multiple magma body probably underlies the caldera; the size of the magma chamber is estimated to be in the range of 100 km^3.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 1503009758

9760 (LA—10234-MS, pp 43-54) **Deep resistivity measurements in the Qualibou caldera, St. Lucia, West Indies.** Ander, M. Aug 1984. NTIS, PC A05/MF A01. File Number DE85005231.

In Evaluation of the St. Lucia geothermal resource: geologic, geophysical, and hydrogeochemical investigations.

A 5.2-km-long dipole-dipole dc resistivity survey was conducted along a north-south-trending line through the Qualibou caldera from just north of Ruby to just north of Victoria Junction. A nominal dipole length of 200 m was selected to obtain high resolution and measurements were made at a total of 32 electrode stations. To get resistivity data to a depth of 2 km, a 35-kW trailer-mounted dc transmitter was used. The survey was centered over Sulphur Springs and the profile location was selected on the basis of the previous British resistivity investigation and the detailed geologic evaluation performed by Wohletz and Heiken of Los Alamos. The apparent resistivity profile shows similar characteristics to the British dipole-dipole data in the upper 700 m. There is an apparent resistivity high of greater than 1000 ohm-m located below the Belfond area. Beneath this resistivity high, there is deeper low apparent resistivity material that is measured at less than 10 ohm-m. The regions containing less than 10 ohm-m material are highly suggestive of zones containing thermal waters. There is a zone of very low apparent resistivity, less than 1 ohm-m, underlying the Etangs area. The zone beneath Etangs is related to thermal upwelling along a fault, probably the caldera-bounding fault. Beneath Sulphur Springs, starting at a depth of approximately 600 m, there is higher apparent resistivity material ranging from 40 ohm-m up to 150 ohm-m in the center of a 1-km-diameter high-resistivity closure. Interpretation of the data strongly suggests the presence of a very hot dry steam field beneath Sulphur Springs. Based on the deep apparent resistivity data, the recommended drilling sites are at: (1) Craters of Belfond; (2) Valley of Sulphur Springs; and (3) Etangs.

9761 (LA—10234-MS, pp 55-88) **Hydrogeochemical evaluation of the Qualibou caldera geothermal system, St. Lucia, West Indies.** Goff, F.; Vuataz, F.D. Aug 1984. NTIS, PC A05/MF A01. File Number DE85005231.

In Evaluation of the St. Lucia geothermal resource: geologic, geophysical, and hydrogeochemical investigations.

Analysis and interpretation of hydrogeochemical data from the Qualibou caldera, St. Lucia, indicate that a geothermal reservoir underlies the Sulphur Springs area and consists of three layers: (1) an upper steam condensate zone; (2) an intermediate two-phase (vapor) zone, which may be restricted to the Sulphur Springs area only; and (3) a lower brine zone. Although temperatures of 212°C at depths of 600 m were encountered by previous drilling at Sulphur Springs, four lines of evidence indicate that temperatures of the brine layer may exceed 250°C. Three other outlying thermal springs discharge in the Qualibou caldera, including two along the northern caldera collapse zone but their geochemistry does not indicate they overlie high-temperature reservoirs. Rather, they appear to be waters derived from the steam condensate layer in the vicinity of Sulphur Springs. If this is the case, it supports the theory that the high-temperature brine upflows in the area of Belfond-Sulphur springs and flows laterally northwards toward the caldera wall. Only the weakest evidence suggests a small component of south lateral flow. On the basis of this evaluation, four sites are suggested for deep exploratory drilling to define the resource and investigate its hydrological dynamics. These sites are at: (1) Belfond area near the youngest silicic volcanism; (2) Sulphur Springs proper; (3) Etangs area near the southern caldera collapse fault; and (4) Diamond Spring near the north caldera wall.

1509 Geothermal Engineering

9762 (DOE/ID—10123) **Hydrothermal injection research program. Annual progress report, FY 1984.** Adams, M.; Capuano, R.G.; Wright, M.; Clemo, T.M.; Hull, L.C.; Miller, J.D.; Skiba, P.A. (Utah Univ., Salt Lake City (USA). Research Inst.; EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1984. Contract AC07-76ID01570. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85004905.

Studies are described to develop tracers which do not interact with a reservoir and to calculate the mixing of injected fluids and native reservoir fluids. Techniques to calculate the reactions of injected fluids with reservoir rocks are presented. Test results at East Mesa and Raft River Geothermal fields are described and interpretations of field mixing in terms of reservoir characteristics are developed. Supporting laboratory experiments on fracture flow are used to assure that interpretations of field data are based on sound theoretical concepts. A computer code, FRACSL, is described which is used to analyze the fluid mixing data obtained in laboratory and field experiments.

9763 (DOE/SF/11556—T2) **East Mesa geothermal pump test facility (EMPTF). Final report.** Olander, R.G.; Roberts, G.K. (Barber-Nichols Engineering Co., Arvada, CO (USA)). 28 Nov 1984. Contract AC03-81SF11556. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004483.

Barber-Nichols has completed the design, fabrication and installation of a geothermal pump test facility at the DOE geothermal site at East Mesa, California which is capable of testing 70 to 750 horsepower downwell pumps in a controlled geothermal environment. The facility consists of a skid-mounted brine control module, a 160 foot below ground test well section, a hydraulic turbine for power recovery, a gantry-mounted hoist for pump handling and a 3-phase, 480 VAC, 1200 amp power supply to handle pump electric requirements. Geothermal brine is supplied to the EMPTF from one of the facility wells at East Mesa. The EMPTF is designed with a great amount of flexibility to attract the largest number of potential users. The 20-inch diameter test well can accommodate a wide variety of pumps. The controls are interactive and can be adjusted to obtain a full complement of pump operation data, or set to maintain constant conditions to allow long-term testing with a minimum of operator support. The hydraulic turbine allows the EMPTF user to recover approximately 46% of the input pump power to help defray the operating cost of the unit. The hoist is provided for material handling and pump servicing and reduces the equipment that the user must supply for pump installation, inspection and removal.

9764 (DOE/SF/12197—T3) **Two-phase flow in geothermal systems. Bi-monthly progress report, October 1-November 30, 1984.** DiPippo, R.; Nikitopoulos, D.E. (Brown Univ., Providence, RI (USA)). Dec 1984. Contract AC03-84SF12197. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004692.

Progress is reported on the following: meetings and related items of interest, operation of the test facility, and theoretical studies. (MHR)

9765 (SAND—84-0857) **Advanced wellbore thermal simulator GEOTEMP2 user manual.** Mondy, L.A.; Duda, L.E. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 209p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85005199.

GEOTEMP2 is a wellbore thermal simulator computer code designed for geothermal drilling and production applications. The code treats natural and forced convection and conduction within the wellbore and heat conduction within the surrounding rock matrix. A variety of well operations can be modeled including injection, production, forward, and reverse circulation with gas or liquid, gas or liquid drilling, and two-phase steam injection and production. Well completion with several different casing sizes and cement intervals can be modeled. The code allows variables suchas flow rate to change with time enabling a realistic treatment of well operations. This user manual describes the input required to proper-

ly operate the code. Ten sample problems are included which illustrate all the code options. Complete listings of the code and the output of each sample problem are provided.

1510 Direct Energy Utilization

9766 **(DOE/SF/11428—T1) Direct use geothermal energy utilization for ethanol production and commercial mushroom growing at Brady's Hot Springs, Nevada. Volume 1. Technical feasibility.** (Geothermal Food Processors, Inc., Fernley, NV (USA)). Sep 1981. Contract FC03-80SF11428. 139p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85004487.

The report is concerned with the technical and economic viability of constructing and operating two geothermally cascaded facilities, a bio-mass fuel ethanol production facility and a mushroom growing facility, where Geothermal Food Processors presently operates the world's largest direct-use geothermal vegetable dehydration facility. A review and analysis of the data generated from the various project tasks indicates that existing, state-of-the-art, ethanol production and mushroom growing technologies can be successfully adapted to include the use of geothermal energy. Additionally, a carefully performed assessment of the geothermal reservoir indicates that this resource is capable of supporting the yearly production of 10 million gallons of fuel ethanol and 1.5 million pounds of mushrooms, in addition to the demands of the dehydration plant. Further, data indicates that the two facilities can be logistically supported from existing agricultural and commerce sources located within economical distances from the geothermal source.

17 WIND ENERGY

1701 Availability (climatology)

9767 **(SAND—84-1227C) Markov method for simulating non-Gaussian wind speed time series.** Veers, P.S.; McNerney, G.M. (Sandia National Labs., Albuquerque, NM (USA); Wind America, Albuquerque, NM). 1985. Contract AC04-76DP00789. 16p. (CONF-850218—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003450.

From ASME wind energy symposium; Dallas, TX, USA (17 Feb 1985).

This paper details a method which can be used to construct a wind simulator capable of generating wind time series with any distribution of hourly averages, exponentially decaying autocorrelation function, and a Gaussian realization of the turbulence. The method is based on a Markov random walk for hourly averages and an inverse hourly transform of the power spectrum to produce short-term turbulence. The Markov process is discussed in the first section, and the turbulence generator is covered in the second section. A description of the applications for which the model was developed follows.

1703 Regulations

9768 **(RFP—3562) Small wind systems field evaluation. Volume I. Program description. Final report.** Dodge, D.M.; Liske, C. (Rockwell International Corp., Golden, CO (USA). Wind Energy Research Center). Jul 1982. Contract AC04-76DP03533. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85003908.

A Field Evaluation Program (FEP) was developed in 1978 to assist in the commercialization process for small wind systems. The program is described, and a description is provided of the institutional issues and barriers encountered and measures taken to assist the state and local governments in resolving them. Barriers were found to involve not only government regulations, but also the distribution of costs and benefits of wind technology and the rate of diffusion of knowledge about wind technology. The availability of capital to finance the production and purchase of wind machines, and the training of qualified dealers and service personnel were also considerable problem areas. (LEW)

1704 Economics

REFER ALSO TO CITATION(S) 1704009768

9769 **(SERI/STR—214-2554) Wind energy systems and nongenerating utilities: an economic assessment and financial impact analysis. Final subcontract report.** Stafford, R.W.; Weaver, N.L. (Regional Systems Services Group, Inc., Englewood, CO (USA)). Nov 1984. Contract AC02-83CH10093. 188p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85002910.

Over the past decade, a substantial amount of research has been completed on the impact of wind energy conversion systems (WECS) on electric utilities. Most of these studies, however, have concentrated on the impact of WECS on generating utilities. This study is unique because it develops and applies a methodology appropriate for nongenerating utilities. Specifically, this study develops methodologies for estimating: (1) the value of WECS to nongenerating utilities; (2) the value of WECS to utility customers based on their individual utility bill savings; and (3) the potential financial impacts that customer-owned WECS could have on these utilities if rate practices such as net metering are employed. Case study results for Union Rural Electric Association, Inc., of Brighton, Colorado, are reported.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 1706009767

9770 **(AUC-IBT—8303) Investigations of material properties of timber for wind turbine blades. Large wind turbine blades of wood.** (Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik). Jul 1983. 44p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750137.

EFP.

This report falls in three parts, all dealing with investigations into mterial properties of the timber selected for production of a prototype wooden blade for one of the wind turbines at Nibe. Part 1 describes static bending tests with sawn timber in the dimensions chosen for the glued laminated timber used in the blades. Part 2 describes static bending tests with glued laminated timber where different orientation of the laminae are investigated with regard to strength and stiffness parameters. Part 3 deals with vibration tests of the glued laminated timber beams to establish values for eigenfrequencies and damping characteristics. The investigations were initiated and sponsored by the Danish wind power programme under the Ministry of Energy and the electric utility companies.

9771 **(DOE/R0/00037—T1) Kivalina wind generator.** Aldrich, D. (Northwest Arctic School District, Kotzebue, AK (USA)). 18 Feb 1984. Contract FG06-79R000037. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004503.

The project reported was to construct a system to harness the winds of an Arctic site to generate electricity that would power a greenhouse where fruit and vegetables could be raised for local consumption. The installation of the tower and an Enertech 4K wind generator are described. (LEW)

9772 **(EEV—83-02) Wind power in electric power system.** (Danske Elvaerkers Forenings Udredningsafdeling (DEFU), Lyngby). Sep 1983. 175p. (In Danish). NTIS (US Sales Only), PC A08/MF A01. File Number DE85750123.

Total utilization of the actual wind power generation is difficult at the present stage as the Danish power plants supply heat parallelly with electricity and large wind power installations cannot provide district heating. Large fluctuations in wind power generation require a number of adjustments in order to integrate wind power into general power systems. Solution of adjustment problems is yet rather expensive and has to be investigated.

9773 **(N—84-29347) Effect of vortex generators on the power conversion performance and structural dynamic loads of the Mod-2 wind turbine. Final Report.** Sullivan, T.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1984. 29p. (NASA-TM—83680; E—2131). NTIS, PC A03/MF A01.

Applying vortex generators from 20 to 100 percent span of the Mod-2 rotor resulted in a projected increase in annual energy capture of 20 percent and reduced the wind speed at which rated power is reached by nearly 3 m/sec. Application of vortex generators from 20 to 70 percent span, the fixed portion of the Mod-2 rotor, resulted in a projected increase in annual energy capture of about half this. This improved performance came at the cost of a small increase in cyclic blade loads in below rated power conditions. Cyclic blade loads were found to correlate well with the change in wind speed during one rotor revolution.

9774 **(SAND—84-1062) Tailored airfoils for vertical axis wind turbines.** Klimas, P.C. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004628.

The evolution of a family of airfoil sections designed to be used as blade elements of a vertical axis wind turbine (VAWT) is described. This evolution consists of extensive computer simulation, wind tunnel testing and field testing. The process reveals that significant reductions in system costs-of-energy and increases in fatigue lifetime may be expected for VAWT systems using these blade elements.

9775 **(SAND—84-1287C) Structural design of the Sandia 34-M Vertical Axis Wind Turbine.** Berg, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 12p. (CONF-850218—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002631.

From ASME wind energy symposium; Dallas, TX, USA (17 Feb 1985).

Sandia National Laboratories, as the lead DOE laboratory for Vertical Axis Wind Turbine (VAWT) development, is currently designing a 34-meter diameter Darrieus-type VAWT. This turbine will be a research test bed which provides a focus for advancing technology and validating design and fabrication techniques in a size range suitable for utility use. Structural data from this machine will allow structural modeling to be refined and verified for a turbine on which the gravity effects and stochastic wind loading are significant. Performance data from it will allow aerodynamic modeling to be refined and verified. The design effort incorporates Sandia's state-of-the-art analysis tools in the design of a complete machine. This paper describes the analytic tools we are using, summarizes the conceptual design procedure and presents portions of our detailed design as it exists in September 1984.

9776 **(SERI/TP—214-2563) Computer analysis of wind turbine blade dynamic loads.** Thresher, R.; Hershberg, E.L.; Wright, A.D. (Solar Energy Research Inst., Golden, CO (USA); Techtronics, Inc., Beaverton, OR (USA)). Nov 1984. Contract AC02-83CH10093. 12p. (CONF-850218—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000530.

From ASME wind energy symposium; Dallas, TX, USA (17 Feb 1985).

The flapping motion of a single wind turbine rotor blade has been analyzed and equations describing the flapping motion have been developed. The analysis was constrained to allow only flapping motions for a cantilevered blade, and the equations of motion are linearized. A computer code, called FLAP (Force and Loads Analysis Program), to solve the equations of motion and compute the blade loads has been completed and compared to measured loads for a 3-bladed downwind turbine with stiff blades. The results of the program are presented in tabulated form for equidistant points along the blade and equal azimuth angles around the rotor disk. The blade deflection, slope and velocity, flapwise shear and moment, edgewise shear and moment, blade tension, and blade torsion are given. The deterministic excitations considered in the analysis include wind shear, tower shadow, gravity, and a prescribed yaw motion.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 2001009772, 9865, 9866, 9981

9777 **(DOE/CS/40403—T1) Closed cycle versus open cycle gas turbines. A review of A.D. Little's ICOP report, Vol. III.** (Vineta, Inc., Falls Church, VA (USA)). 24 Aug 1984. Contract AC01-81CS40403. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85000564.

This report addresses the question how coal fired closed cycle gas turbine cogenerators perform economically in comparison to coal fired open cycle gas turbine configurations. The return on equity (ROE) was selected as a measure of economic performance. The investigations determined attainable ROE's for three industries (Agrichemical Products, Brewery, Kraft Paper Mill) for closed and open configurations as proposed in a report on the Industrial Cogeneration Optimization Program. Life cycle analyses were conducted assessing this impact of various parameters upon the rankordering of ROE's for the four topping configurations (one closed cycle, three open cycle gas turbines).

9778 **(EPRI-CS—3717) Assessment of fossil steam bypass systems. Final report.** Steltz, W.G.; Rosard, D.D. (Power Dynamics, Inc., Broomall, PA (USA)). Oct 1984. 357p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $28.00. File Number TI85920084.

Small steam bypass systems bring substantial fuel savings while they solve many of the problems caused by using baseload generating units for cyclic operation. Individual utilities can evaluate bypass systems for their new or retrofit applications using the step-by-step method developed in this study.

9779 **(EPRI-EL—3712) Radio interference from HVDC converter stations. Final report.** Slapp, J.; Bhatti, J.S.; DeVore, R.V. (International Engineering Co., Inc., San Francisco, CA (USA); Ohio State Univ., Columbus (USA). Dept. of Electrical Engineering). Oct 1984. 345p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920151.

Electromagnetic (EM) wave effects at high-voltage direct current (HVDC) converter stations were investigated to obtain: (1) a better understanding of EM phenomena; (2) an improved capability to predict EM field strengths; and (3) an analysis of mitigation methods. Field measurements were performed at three converter stations of different design, manufacture, and dc voltage levels; two stations used thyristor valves and one used mercury arc valves. The measurements included both electric and magnetic field strengths and high-frequency characteristics of HVDC converter station equipment. Information is provided on the techniques developed and used for translating equipment measurements into model components, together with procedures and assumptions used in building the model. Mitigation methods were investigated and practical calculation methods developed that are suitable for use in the design of converter stations. It is shown that valve-hall screening is effective in containing EM waves but that conductors through building walls provide a path for some EM energy to reach the converter station exterior. Mitigation of such conducted noise includes reduction in the generation of EM energy and/or filtering of generated noise. The better understanding of the EM phenomenon that resulted from this project has prepared the way for development of digital methods for calculating and predicting EM field strengths in an HVDC converter station and its exterior and design of filter circuits for mitigating undesirable EM wave effects. Additional research on the computer model and filter design is planned.

9780 **(EPRI-EL—3771) Critical evaluation of design methods for foundations under axial uplift and compression loading. Final report.** Stas, C.V.; Kulhawy, F.H. (Cornell Univ., Ithaca, NY (USA). Geotechnial Engineering Group). Nov 1984. 191p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $17.50. File Number TI85920125.

This study is a critical evaluation of the analysis and design methodology recently proposed for the foundations of transmission line structures. A large data base of field load test case histories is used for detailed analysis of: (1) undrained capacity of drilled shafts, driven piles, and spread-type foundations in cohesive soils; (2) drained capacity of the same foundation types in cohesionless soils; and (3) uplift movements of drilled shafts and spread-type foundations. Both uplift and compression loading are evaluated, but the emphasis is on uplift. The evaluation of soil design parameters is considered, and new procedures are presented for estimating tip suction and in-situ horizontal soil stresses. The foundation analysis results are compared to the field load test data, and the statistics for these comparisons are presented. The results demonstrate the general usefulness of the recently proposed design methodology, subject to certain limitations. Undrained side resistance is discussed in detail, and recommendations are made for improving the available methods. Uplift movement predictions are shown to need improvement and warrant further study. Finally, the application of these results to current analysis and design practice is presented.

9781 **(KHM-TR—37) Changing to domestic fuels or municipal waste in coal boilers. Technical and environmental problems.** Malin, S.; Aastroem, L. (Statens Vattenfallsverk, Vaellingby (Sweden). Projekt KOL-HAELSA-MILJOE). 1983. 107p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750165.

This study examines from technical and environmental point of view, the impact of changing to domestic fuels (Swedish) or municipal waste in coal boilers, or preparing boilers for conversion or cofiring at the time of construction. The study is on boilers in the range 5-100 MW. The actual firing-methods are chain-grate fluidized bed and suspension. In multifuel boilers, mechanical grates for domestic fuels can be used too. Conversion of suspension-fired coal boilers, requires more extensive modifications. Fluidized bed boilers have been developed with multi-fuel-firing in mind. Conventional bunkers, designed for storing and feeding of coal to the boiler are not suitable for handling of domestic fuels alone or as a major constituent in a mixture with coal, unless the fuel is pelletized. Ash handling systems of coal fired plants are in principle suitable for domestic fuels. Municipal waste has rather complicated burning properties and must undergo extensive pretreatment to make it suitable for firing in conventioanl steam boilers. Fuel properties of waste differ from those of coal. The faster burning and lower ash melting temperatures are probably the most decisive production limiting factors. The changes in flue gas composition that can be expected when changing from coal to waste fuel firing are discussed.

9782 **(PB—84-234186) Study of electricity storage and central electricity generation.** Infield, D.G. (Rutherford Appleton Lab., Chilton (UK)). 1984. 50p. (RAL—84-045). NTIS, PC E04/MF E04.

A systems approach has been adopted for the evaluation of energy storage for large scale electricity generation. Fuel cost savings derived from the various functions of electricity storage have been estimated. Other advantages attributable to storage such as capacity credit and increased security of supply have not been dealt with in this analysis. The fuel cost savings associated with central electricity storage are usefully broken down into the following categories; immediate reserve, reserve to cover scheduling and dispatching error, and load-levelling (including the more restricted case of peak lopping). (Copyright (c) Science and Engineering Research Council 1984.)

9783 **Performance of heat exchanger materials in Curtiss-Wright PFBC tests.** *Materials and Components in Fossil Energy Applications;* No. 47, 1-5(1 Dec 1983).

Integration of a pressurized fluidized bed (PFB) coal combustor with a gas turbine/steam turbine combined cycle is an economic and environmentally attractive alternative to pulverized coal steam boilers and flue gas desulfurization for utility power plants burning high sulfur coal. A process by which a coal-fired, air-cooled PFBC may be integrated into a combined cycle system is presented. The process can provide a coal pile-to-busbar efficiency of approximately 40%. About one-third of the air from the gas turbine's compressor is used to fluidize the bed and support combustion, and the remaining air is indirectly heated - essentially to bed temperature - by flowing through an in-bed tubular heat exchanger. In this system, 60% of the total plant power is produced by the gas turbine and 40% is produced by the steam system.

9784 **Performance of high-temperature valves in the IEA-Grimethorpe PFBC.** *Materials and Components in Fossil Energy Applications;* No. 47, 5-8(1 Dec 1983).

The operation of probes and other research instrumentation equipment in the pressurized fluidized bed combustion experimental facility at Grimethorpe requires valves capable of operating under extreme conditions of pressure and temperature. The valves must be capable of continuous operation at the maximum design conditions of 1.2 MPa at 950°C sealing against solids and gases. Valve sizes in the range of 50 to 150 mm nominal bore (n.b.) are required for use in the combustor ash removal and sampling systems and the primary cyclone dust discharge and sampling pipes. The operation and performance of these valves are discussed.

2002 Environmental Aspects

REFER ALSO TO CITATION(S) 2002009491, 9492, 9493, 9494, 9497, 9506, 9507, 10394

9785 **(TVA/ONR/WRF—84/6) Gallatin steam-electric plant: paddlefish investigations. Progress report.** Pasch, R.W. (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Sep 1984. 6p. NTIS, PC A02/MF A01. File Number DE85900874.

TVA biologists investigated causes and impacts of young-of-year (YOY) paddlefish impingement at the Gallatin Steam-Electric Plant (GAF) for several years. During the past few years these studies concentrated on determining numbers of YOY paddlefish in Old Hickory Reservoir and factors influencing their abundance. TVA hoped to relate estimated abundance to impingement mortality to assess effects of this mortality on adult stocks. Only two paddlefish (both YOY) were impinged during 24-hour samples collected once each week from October 1983 to June 1984. Estimated total impingement for this period was 14. TVA recommends the two-tiered activity schedule instituted in fiscal year 1984 be continued in fiscal year 1985. At the lower level, impingement sampling will be done weekly and number of 1985 year-class paddlefish likely to be impinged will be predicted. If paddlefish impingement is high during winter 1984 to 1985, contrary to expectations, an intensive sampling and analysis program will be done.

2003 Power Transmission And Distribution

9786 **(EPRI-EL—3766-Vol.1) Field determination of PCB in transformer oil. Volume 1. Chlorine analysis by x-ray emission.** Hirst, R.G.; McQuade, J.M.; Rouse, T.O. (General Electric Co., Pittsfield, MA (USA). Large Transformer Business Div.). Oct 1984. 55p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $10.00. File Number TI85920127.

This investigation has shown that the quantitative measurment of low concentrations of chlorine in transformer oil was possible by x-ray emission and that the determination of the total chlorine content of an oil could be related to the PCB concentration in such a way as to make the technique viable as a PCB screening tool. Commercially available, portable, energy dispersive x-ray instruments were evaluated as to their ability to measure total chlorine concentration and their effectiveness in screening field samples. The Horiba Mesa-200 instrument was found to be accurate, reliable, simple to operate and suitable as a field monitor.

9787 **(EPRI-EL—3766-Vol.2) Field determination of PCB in transformer oil. Volume 2. Clor-N-Oil PCB screening test. Final report.** Fisher, D.J.; Rouse, T.O.; Lynn, T. (General Electric Co., Pittsfield, MA (USA). Large Transformer Div.; Dexsil Chemical Corp., Hamden, CT (USA)). Oct 1984. 39p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920129.

The requirements for handling and disposing of transformer minerals oils containing more than 50 ppM PCB are, by federal

regulation, different from those for oils containing lower concentrations. A rapid and simple test to distinguish between samples containing more than or less than this concentration would simplify proper control of transformer oils. This report describes the development of a small disposable test kit that can be used on-site to screen the chlorine content of transformer oils. The kit consists of two soft plastic tubes in which thin walled glass ampules containing premeasured amounts of reagents are broken. The reaction sequence in the kits converts the chlorine in PCB to chloride ion. The color of the liquid in the kit after the last step is blue to purple if the chloride content due to the initial chlorine concentration of the oil is less than 20 ppM. If the chlorine content of the oil is below 20 ppM, the PCB content must be below 50 ppM. The liquid is colorless if the chlorine content is greater than 20 ppM. In this latter case, it is necessary to determine by gas chromatography whether the PCB content is actually greater than 50 ppM or if there is some other source of chlorine in the oil.

21 NUCLEAR POWER PLANTS

9788 **(NUREG—0020-Vol.8-No.10) Licensed operating reactors. Status summary report, data as of September 30, 1984. Volume 8, No. 10.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Nov 1984. 403p. NTIS, PC A18/MF A01 - GPO*. File Number TI85900701.

This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the Utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capability, reactor years of experience and non-power reactors in the United States. The percentage computations, Items 20 through 24 in Section 2, the vendor capacity factors, and actual vs. potential energy production are computed using actual data for the period of consideration. The percentages listed in power generation are computed as an arithmetic average. The factors for the life-span of each unit (the Cumulative column) are reported by the utility. Utility power production data is checked for consistency with previously submitted statistics.

9789 **(NUREG/CR—4019) New steam cooled reactor.** Schultz, M.A.; Edlund, M.C. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mechanical Engineering). Nov 1984. 173p. NTIS, PC A08/MF A01 - GPO* $6.00. File Number TI85900860.

A novel concept is described for a nuclear power plant that is ultra safe based on current knowledge of nuclear reactor safety. Both burner and breeder-type cores are studied. The concept utilizes steam-cooling during normal operation with automatic shutdown and heat removal by natural convection under off-normal conditions.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 2101009811, 9812, 9891, 9894, 9914, 9920, 9927, 9940, 9952

9790 **(BNL-NUREG—29832) Benchmarking of ARMP modules against BWR measured data.** Cokinos, D.; Kohut, P.; Carew, J.; Diamond, D. (Brookhaven National Lab., Upton, NY (USA)). Jun 1981. Contract AC02-76CH00016. 7p. (CONF-811103—31). NTIS, PC A02/MF A01 - GPO. File Number TI85003655.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

With the exception of the work presented informally by utility workers at EPRI- or NRC-sponsored meetings, relatively little information is available in the open literature on results of BWR benchmark studies. This paper summarizes our work in the benchmarking of specific modules of the Advanced Recycle Methodology Program (ARMP) code system against measurements obtained during the operation of Quad Cities Cycles 1 and 2.

9791 **(CONF-800607—35) Relative importance of attenuation and reactivity effects in explaining local and global BWR neutron noise.** Sweeney, F.J.; Robinson, J.C. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1980. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01 - GPO. File Number TI85003572.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

Recent studies show that in-core neutron detector response to boiling can be described in terms of two physical processes: (1) attenuation (shielding), by which boiling noise perturbs the moderator density between the fuel and detector locations; and (2) reactivity, by which boiling perturbs the moderator density, and thereby changes the fission rate in the fuel. In this work the fuel pins, moderator flow channels, and neutron detectors located in the bypass region were modeled explicitly in the radial direction since the attenuation effect of void fluctuations is accounted for primarily through these heterogeneities. The attenuation and reactivity effects on the detector response due to void fluctuations were separated by performing two calculations with the computer program TASK, which is a one-dimensional, frequency-dependent, transport theory kinetics code.

9792 **(EPRI-NP—3719) Analysis of the Browns Ferry Unit 3 irradiation experiments. Final report.** Simmons, G.L. (Science Applications, Inc., La Jolla, CA (USA)). Nov 1984. 118p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $13.00. File Number TI85920146.

The results of the analysis of two experiments performed at the Browns Ferry-3 reactor are presented. These calculations utilize state-of-the-art neutron transport techniques and a new neutron cross-section library that has been developed for LWR applications. The calculations agree well with the experimental data obtained in irradiations inside the reactor vessel. For the measurements performed in the reactor cavity, the calculations agree well at the reactor midplane. Accurate determination of the axial distribution of the neutron fluence in the reactor cavity depends on having a concise representation of the axial-void distribution in the core. Detailed data are presented describing the procedures used in the generation of the new cross-section library that has been named SAILOR. This library is available from the Radiation-Shielding Information Center.

9793 **(EPRI-NP—3782) Neutron radiography of fuel rods irradiated for four cycles at the Quad Cities-1 BWR.** Kosanke, H.D.; Rose, P.C. (General Electric Co., San Jose, CA (USA)). Nov 1984. 53p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $10.00. File Number TI85920120.

This report describes neutron radiographic measurements of 10 fuel rods performed at the Quad Cities-1 site. The rods were UO_2-Gd_2O_3 and UO_2-PuO_2 (solid and annular pellet) types which were operated under controlled conditions for cycles 2-5.

9794 **(GEAP—22076-Vol.1) Fuel ramp tests in support of a barrier fuel demonstration. Volume 1.** Davies, J.H.; Rosicky, E.; Esch, E.L.; Rowland, T.C. (General Electric Co., San Jose, CA (USA)). Jul 1984. Contract AC02-77ET34001. 184p. NTIS (US Sales Only), PC A09/MF A01; 1; GPO Dep. File Number DE85004117.

The pellet-cladding interaction (PCI) fuel failure mechanism is a stress corrosion cracking (or liquid metal embrittlement) phenomenon induced by embrittling fission product species. Barrier fuel was developed as a materials solution to PCI. Barrier fuel rods plus reference standards were base-irradiated in power reactors in special segmented test rod (STR) assemblies, then power ramp tested in a test reactor. The design and operation of the STR assemblies is described and details of the ramp test facilities are provided. A total of 154 power ramp tests were performed on 113 fuel rods, including reference standards, Zr-barrier and Cu-barrier rods, at exposures up to 30 MWd/kg U. The ramp tests were severe tests designed to provide a measure of the improvement in PCI performance of barrier fuel over reference nonbarrier fuel. Ramp test results were confirmed by post-irradiation examination (PIC) and detailed metallography was performed to characterize the condition

of the barriers following service. Results of the ramp tests and PIE characterization data are discussed. Zr-barrier fuel was selected for the large scale demonstration, which is being performed in the Quad Cities-2 power reactor.

9795 **(GEAP—22076-Vol.2) Fuel ramp tests in support of a barrier fuel demonstration. Volume 2.** Davies, J.H.; Rosicky, E.; Esch, E.L.; Rowland, T.C. (General Electric Co., San Jose, CA (USA)). Jul 1984. Contract AC02-77ET34001. 750p. NTIS (US Sales Only), PC A99/MF A01; 1; GPO Dep. File Number DE85004120.

This volume consists of three appendices: irradiation power histories, ramp test performance details and data presentation, and nondestructive post-irradiation examination data summary displays. (DLC)

9796 **(IPEN-Inf—13) Neutronic calculations with transport and diffusion computer codes for light-water-moderated critical assembly with UO_2 enriched at 4.75% as fuel.** Sabundjian, G.; Nakata, H. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Feb 1983. 20p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703431.

The neutronic calculational procedure in a 4.75% enriched UO_2 fueled light-water-moderated critical assembly was tested, using the transport codes and diffusion code available at the Instituto de Pesquisas Energeticas e Nucleares. The results of the tested codes, LEOPARD, CITHAMMER, LASER, GELS and CITATION, were found to be satisfactory, and only a slight advantage is presented by CITHAMMER code.

9797 **(IPEN-Pub—51) Fuel behavior modeling using the MARS computer code.** Faya, S.C.S.; Faya, A.J.G. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Jan 1983. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703447.

The fuel behaviour modeling code MARS against experimental data, was evaluated. Two cases were selected: an early commercial PWR rod (Maine Yankee rod) and an experimental rod from the Canadian BWR program (Canadian rod). The MARS predictions are compared with experimental data and predictions made by other fuel modeling codes. Improvements are suggested for some fuel behaviour models. Mars results are satisfactory based on the data available.

9798 **(N—84-30326) Calculation of crack behaviour on exposure to thermal shock.** Stamm, H. (UKAEA Risley Nuclear Power Development Establishment. Technical Services and Planning Directorate). Apr 1984. 14p. British Library Lending Div., Boston Spa, England.

Failures in light water reactors (LWR) necessitating emergency cooling involve the surface of parts of the reactor pressure vessel or pipe system of the primary circuit being brought into contact with cold feedwater, thus causing the phenomenon of thermal shock. The essential elements of crack propagation calculation described herein, with particular emphasis, were placed on thermal fatigue. The propagation of a surface crack in a circular steel plate was used as a example to demonstrate the method of calculation. The stress intensity factors were calculated by the weighted functions method.

9799 **(NIIAR—27(592)) Tank type boiling water cooled reactor core with natural circulation at low pressure.** Fedyakin, R.E.; Antonov, S.N.; Zharkov, A.V. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1983. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703437.

On the basis of the analysis of results of neutron physics fuel lattice calculations, the dependence of the steam temperature and void coefficients of the tank-type boiling water cooled reactor with natural circulation on the water-to-fuel volume ratio Vsub(Hsub(2)O)/Vsub(UOsUb(2)), fuel elements diameter, fuel enrichment and burnup at different steam content in the reactor core is investigated. The calculations are realized by the UNIRASOS program. In calculations the following geometric dimensions and other parameters of the VK-50 reactor core are used: equivalent diameter = 1.8 m, height = 2 m, fuel-sintered UO_2 of 10.2 g/cm³ density, fuel elements diameter = 9.1 and 13.6 mm, Zr can thickness-0.65 and 0.9 mm, fuel pellet diameters = 7.6 and 11.6 mm. As a result of calcUlation it has been found that the main influence on density reactivity coefficients is affected by the Vsub(Hsub(2)O))/Vsub(UOsUb(2)) ratio value. Its increase leads to the reduction of the absolute value of these coefficients. The conclusion is drawn that for boiling reactor core with Vsub(Hsub(2)O))/Vsub(UOsub(2)) = 3. Under 3 MPa pressure one can obtain a deeper fuel burnup, while permissible volume heat flux densities would be close to the volume densities obtained in the VK-50 boiling reactor under 7 MPa pressure.

9800 **(NIIAR—33(598)) Steam content of the two-phase flow in the VK-50 boiling water cooled reactor draught section.** Fedulin, V.N.; Shmelev, V.E.; Solodkij, V.A.; Bartolomej, G.G. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1983. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703438.

Results are presented of experimental investigation of the two-phase steam-water coolant flow hydrodynamics within the VK-50 reactor draught section. On the basis of the analysis of the obtained data, a two-phase coolant flow model in a large diameter channel is proposed. It is shown that the steam-content distribution in the volume of the draught section has a pronounced non-equilibrium character manifested in the steam migration from the periphery to the central region. A minimum value of the steam content at the periphery is attained at the 0.7-1.0 m height; it is followed by a partial steam content levelling over the section. The total steam content levelling over the cross section of the draught section does not take place. The steam distribution in the water layer over the draught section (overflow zone) is also nonuniform over the reactor section. The non-uniform steam distribution enchances with reduction in pressure.

9801 **(NUREG—1012) Technical specifications Shoreham Nuclear Power Station, Unit No. 1 (Docket No. 50-322). Appendix A to License No. NPF-19.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Dec 1984. 495p. NTIS, PC A21/MF A01 - GPO* $10.00. File Number TI85900854.

This appendix includes definitions, safety limits and limiting safety system settings, limiting conditions for operation and surveillance requirements, bases, design features, and administrative controls. (DLC)

9802 **(STUDSVIK-NR—82/95) Identification of common-cause candidates in the residual heat removal system in Ringhals 1.** Stenquist, C. (Statens Kaernkraftsinspektion, Stockholm (Sweden)). Feb 1983. 65p. (SAEK—1-S(82)1). NTIS (US Sales Only), PC A04/MF A01. File Number DE84703465.

Within the joint Nordic project NKA/NGS SAEK-1, a study was performed to investigate the applicability of the computer program SETS for identification of common-cause failures. SETS (Set Equation Transformation System) has been developed by SANDIA National Laboratories. The Residual Heat Removal System in Ringhals 1 was chosen as a reference system. An integral part of the study was to establish a fault tree of the system and to specify the common dependences between the primary events as input to the program. These dependences consist of special conditions and secondary causes. The program analyses the fault tree and determines the minimal cut set for the TOP event. A transformation of the special conditions and secondary causes, executed on the minimal cut set equation, results in the replacement of each primary event by its special condition or secondary cause equation. This leads to the identification of the common-cause candidates. In this study over 4000 minimal cut sets were obtained, of which about 805 consisted of common-cause candidates. The result indicates that it should have been very difficult to analyse such a large fault tree with the comprehensive information on common dependences without appropriate computer aid. The SETS program appears to possess the qualifications that make it an efficient tool for the qualitative analysis of common causes.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 2102009796, 9797, 9798, 9868, 9884, 9885, 9886, 9887, 9888, 9889, 9890, 9894, 9896, 9898, 9904, 9905, 9906, 9910, 9913, 9918, 9919, 9920, 9922, 9923, 9927, 9932, 9933, 9939, 9940

9803 **(EGG-M—18284) Analysis of H.B. Robinson Unit-2 pressurized thermal shock transients.** Ogden, D.M.; Fletcher, C.D.; Davis, C.B. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 26p. (CONF-8410142—56). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003409.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

In support of the USNRC PTS Integration Study for the resolution of USI A-49, analyses were performed of 180 overcooling sequences that were defined by ORNL for the H.B. Robinson Unit-2 (HBR-2) plant. The analyses produced vessel downcomer temperature, pressure and heat transfer coefficient histories (the primary parameters of interest for PTS) for the 180 overcooling sequences. The information was used to perform fracture mechanics and multidimensional effects analyses to determine for each sequence the probability of vessel failure.

9804 **(EPRI-NP—3732) Reflux condensation in a closed tube.** Tien, C.L. (California Univ., Berkeley (USA). Dept. of Mechanical Engineering). Oct 1984. 118p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $13.00. File Number TI85920107.

Reflux condensation which may have an appreciable effect on the reflood process in the reactor core during the loss-of-coolant accident is investigated experimentally and analytically in the present work using the vertical two-phase closed thermosyphon. The condensation heat transfer coefficients of the countercurrent vapor-liquid flows are locally measured along the condenser wall. The results indicate that Nusselt's solution for film condensation cannot interpret satisfactorily the observed trend. Further improvements are made to consider the effects of interfacial shear, waviness and non-condensable gas on condensation. The vapor shear retards the condensate flow and thus increases the film thickness, which results in lower heat transfer coefficients than those calculated from Nusselt theory. Modified Fanning friction factors which account for the augmentation of interfacial shear through phase change are used to evaluate the reduction of heat transfer by vapor shear. On the other hand, the waves appearing on the interface can enhance heat transfer rates. Such enhancement is determined by solving numerically the nonlinear equation for the wavy interface. When noncondensable gases are present in the system, they will accumulate at the condenser end forming a gas barrier to the vapor and shut off that portion. A two-dimensional model is developed to include both axial and radial diffusion of gas mass. This two-dimensional analysis indicates the inadequacy of the common one-dimensional diffuse-front model in considering only axial diffusion of gas in most physical systems.

9805 **(EPRI-NP—3734) Guidelines for PWR pressure protection system optimization. Final report.** Sklencar, A.M.; Meliksetian, A.; Smith, L.C.; Shopsky, W.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Oct 1984. 274p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $22.00. File Number TI85920142.

Analyses were performed based on an upgraded design basis for the pressure protection system with the intent of investigating areas of potential economies and optimization associated with the pressure protection system in a PWR plant. Guidelines for system optimization are presented, and benefits, costs of system implementation and system limitations are discussed. In addition, the reliability of system alternatives, the impact of the system on piping reaction forces, the effect of operation of other systems with pressure control capability, and the influence of the cold overpressure mitigation function on system design are also investigated.

9806 **(N—84-30352) Neutron embrittlement of the reactor vessel in Borssele as determined from Charpy specimens.** Oosterkamp, W.J.; Dufour, L.B. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). 1983. 12p. NTIS, PC A02/MF A01.

Two sets of Charpy specimens were retrieved from a nuclear power reactor after two and four cycles of operation, respectively. The neutron fluxes at the sample positions and at the vessel wall were calculated with a point kernel method and S2 calculations. The calculated fluxes at the two specimen positions agree with fluences measured by threshold detectors. The reference temperature of nil ductility was determined from the Charpy tests by a tanh fit procedure. An extrapolation to a 40 yr vessel life, based on a square root dependence of the change in the reference temperature with effective full power years was made. Under these assumptions the heat affected zone material reaches 296 K. The other materials remain below 280 K. The vessel life therefore is not limited by embrittlement. (ESA)

9807 **(NUREG—0973) Technical specifications Waterford Steam Electric Station, Unit No. 3 (Docket No. 50-382). Appendix A to License No. NPF-26.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Dec 1984. 501p. NTIS, PC A22/MF A01 - GPO* $10.00. File Number TI85900645.

This appendix includes the following: definitions, safety limits and limiting safety system settings, bases, limiting conditions for operation and surveillance requirements, design features, and administrative controls. (DLC)

9808 **(NUREG—1099) Technical specifications Catawba Nuclear Station, Unit 1 (Docket No. 50-413). Appendix A to License No. NPF-31.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Dec 1984. 525p. NTIS, PC A22/MF A01 - GPO* $10.00. File Number TI85900853.

This appendix includes: definitions, safety limits and limiting safety system settings, limiting conditions for operation and surveillance requirements, bases, design features, and administrative controls. (DLC)

9809 **(NUREG/CR—1903) Advanced two-phase flow instrumentation program. Quarterly progress report, July-September 1980.** Turnage, K.G.; Davis, C.E.; McCulloch, R.W.; Anderson, R.L.; Miller, G.N.; Rogers, S.C. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract AC05-84OR21400. 22p. (ORNL/NUREG/TM—430). NTIS, PC A02/MF A01 - GPO. File Number TI85004739.

Work performed to develop and evaluate liquid level sensors for in-vessel use in pressurized-water reactors is described. Techniques used to fabricate heated thermocouple (HTC) probes are presented. Experiments were performed with five thermal-type liquid level sensors in natural convection to saturated water and steam. Pressures in those tests ranged from 0.1 to 8.6 MPa (15 to 1250 psia). Test goals were to study sensor repeatability and optimize splash shield designs. An HTC was installed in the upper plenum of the Thermal Hydraulic Test Facility and tested during steady-state film boiling tests. The HTC performed well except at high test section outlet velocities. Tests intended to prove the principle of the temperature-compensated ultrasonic liquid level instrument were performed in high-temperature saturated liquid water and steam. The mean densities obtained using the ultrasonic device agreed with those from pressure difference measurements, within experimental error.

9810 **(NUREG/CR—4032) Detection of steam generator tube leaks in pressurized water reactors.** Roach, W.H. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1984. Contract AC07-76ID01570. 19p. (EGG—2351). NTIS, PC A02/MF A01 - GPO. File Number TI85003960.

This report addresses the early detection of small steam generator tube leaks in pressurized water reactors. It identifies physical parameters, establishes instrumentation performance goals, and specifies sensor types and locations. It presents a simple algorithm that yields the leak rate as a function of known or measurable quan-

tities. Leak rates of less than one-tenth gram per second should be detectable with existing instrumentation.

9811 **(NUREG/CR—4070-Vol.1) Bivalve fouling of nuclear power plant service-water systems. Volume 1. Correlation of bivalve biological characteristics and raw-water system design.** Neitzel, D.A.; Johnson, K.I.; Page, T.L.; Young, J.S.; Daling, P.M. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1984. Contract AC06-76RL01830. 136p. (PNL—5300-Vol.1). NTIS, PC A07/MF A01 - GPO $5.50. File Number TI85004032.

Fouling of raw-water systems in nuclear power plants in the US can affect the safe operation of a power plant. This report describes correlations between the biology of bivalve organisms and the design and operation of power plants that allow bivalves to enter and reside in nuclear power plants. Discussions are focused on safety-related raw-water systems subject to fouling by the Asiatic clam (Corbicula fluminea), the blue mussel (Mytilus edulis), and the American oyster (Crassostrea virginica). Score sheets to rate fouling potential of power plant systems and components are provided.

9812 **(SVF—146) Inspection of condensers in Ringhals 1 and 4 on 17th-18th August 1982, 51 619/1, 20th August 1982.** Henrikson, S. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Dec 1983. 41p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750206.

The inspection at condenser 11 indicates that the earlier observed vertical streaks of rust running from certain tubes have not been caused by crevice corrosion in the tube plate but by rusty water from the tubes during shutdown. This conclusion must be verified by further inspections of the condenser during coming shutdowns, but at the latest during the 1983 annual overhaul. Earlier potential measurements on 254 SMO and titanium in Ringhals and exposure tests with these two materials have shown that the combination of these two materials involves no risk of galvanic corrosion. As, furthermore, no difference as regards corrosion has been observed between the tube plate in the inlet box to section 5, which throughout has had no sacrificial anodes of iron, and the other tube plates, it appears probable that all sacrificial anodes can be removed as unnecessary at the 1983 overhaul. Until then the cathodic protection should be preserved in its present form, i.e., with anodes in all water boxes except in the inlet box to section 5. SLA, finally, should arrange for grinding of the approx. 1 dm^2 rusty surface in the uppermost part of the tube plate in the inlet box to the latter section. The tube plate of condenser 41, which is coated with Inerta 160 epoxy resin, was also inspected and found to in excellent condition.

9813 **(UFRJ-COPPE-PEN—121) Simplified calculation of the axial distribution temperature in a medium channel of PWR.** Silva Neto, A.J. da; Roberty, N.C. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). May 1983. 69p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE84703448.

A subroutine for the calculations of the axial distribution temperature of a pressurized water reactor coolant was developed. The values of water specific heat in function of the temperature were adjusted by the least square method which allows the explicit determination of the temperature field.

9814 **(UFRJ-COPPE-PEN—123) CRISTE - a subcomputer code for axial distribution, transient, of temperatures in a reactor channel of PWR.** Silva Neto, A.J. da; Roberty, N.C.; Carmo, E.G.D. do. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). Dec 1983. 89p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE84703449.

The subroutine CRISTE was developed to calculate the temperature distribution for transients in a PWR coolant. The Crank-Nicholson approximation was used for the temporal discretization and a semi-analytical spatial solution was obtained. The temperature in the cladding was simulated by a routine adapted from the permanent distribution, and was used in on iterative method, following CRISTE subroutine.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 2103009926, 10086

9815 **(BNWL-SA—3621) Measurement of the infinite medium multiplication factor as a function of temperature for a $^{235}UC_2$-$^{232}ThO_2$-C lattice.** Oakes, T.J. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1970. Contract AC06-76RL01830. 46p. NTIS, PC A03. File Number DE85005114.

Experimental values for the infinite medium multiplication factor, k/sub infinity/', have been determined, as a function of temperature, using the High Temperature Lattice Test Reactor, for a graphite-moderated lattice fueled with a $^{235}UC_2$-$^{232}ThO_2$-C fuel mixture. These results provide valuable checkpoints for testing computational methods currently being applied in the design of High Temperature Gas-cooled Reactors.

9816 **(IAE—3736/5) Studying the problems of calculational homogenization of absorbing rods placed in a radial reflector.** Demin, V.E.; Kalina, E.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1983. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703430.

A method for determination of homogenization coefficients permitting to calculate effective cross sections for the materials of the VG-400 reactor absorbing rods placed in the radial reflector is suggested. The calculations are conducted in two stages. Real sizes of the rods their heterogeneous structure and location in the reactor are taken into account at the first stage. The calculations are performed according to the PNK program. The values of effective neutron multiplication factors Ksub(ef) for the heterogeneous system and the values of mean fluxes in certain zones of the rods and the given annular zones around them are determined. The effective cross sections for materials of absorbing rods homogeneously distributed in zones including the rod and an annular with fixed dimensions around it at the condition of Ksub(ef)sup(hom)=Ksub(ef)sup(het) are calculated at the second stage. The obtained results can be used for homogenization of the rods in cells of the finite difference network while calculating the reactors using the numerical methods.

9817 **(ORNL/TM—9161) Vapor pressure of plutonium carbide adsorbed on graphite.** Tallent, O.K.; Wichner, R.P.; Towns, R.L.; Godsey, T.T. (Oak Ridge National Lab., TN (USA)). Sep 1984. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003798.

An investigation was conducted to obtain data needed to make realistic estimates of plutonium contamination in the primary coolant system in High Temperature Gas-Cooled Reactors (HTGRs). The vapor pressure of plutonium over plutonium sesquicarbide (Pu_3C_3) adsorbed on the surface of H-451 graphite was found to be defined by adsorption isotherms at test temperatures of 1000, 1200, and 1400°C. The vapor pressures at low concentrations of Pu_3C_3 on the surface of the graphite were up to three orders of magnitude below that of pure Pu_3C_3 at a given temperature. The heat of adsorption increases with decreasing Pu_3C_3 surface coverage with the measured value at 0.05 μmol Pu_3C_3/m^2 being 107.9 kcal/mol. The Pu_3C_3 concentration required for monolayer surface coverage on the graphite was found to be 3.27 $\mu mol/m^2$.

9818 **High-temperature structural engineering data needs.** Hughes, P.T.; Allen, D.C. (General Electric Company, Advanced Reactor Systems Department, Sunnyvale, California). *Nuclear Technology;* **66**: No. 2, 661-666(Sep 1984).

The major technical obstacle to construction of a 950°C commercial gas-cooled reactor is the absence of a clear basis for the structural design of the metal components. The basis of existing design rules for temperatures to 800°C has been subject to joint U.S. and Federal Republic of Germany review. The result of this review has been used to define complementary structural design programs. Three significant aspects of structural design at 950°C

not directly addressed by existing codes have formed a partial basis for work in the United States. These are: design for flaws, for environmental effects, and for a clearly stated definition of reliability. The importance of these three aspects is illustrated, for example, by the fact that component materials, such as the nickel alloys, exhibit markedly reduced toughness below the operating temperature range after elevated temperature exposure. Such materials also display a susceptibility to major mechanical property changes resulting from carbon uptake or loss to the cooling gas. Also there is no satisfactory precedent from which to define design margins. A structural design program is described, some elements of which are being developed.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 21040010310

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 2105009899, 9902, 9915, 9931

9819 **(DOE/NBM—5002872) JUPITER-II Program: ANL analysis of ZPPR-13A and ZPPR-13B.** Collins, P.J.; Brumbach, S.B. (comps.). (Argonne National Lab., IL (USA)). 9 Aug 1984. Contract W-31-109-ENG-38. 259p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85002872.

The ZPPR-13 experiments provide basic physics data for radial-heterogeneous LMFBR cores of approximately 700 MWe size. Assemblies ZPPR-13A, ZPPR-13B and ZPPR-13C comprised the JUPITER-II cooperative program between US-DOE and PNC of Japan. The measurements were made between August 1982 and April 1984. This report describes in detail the results of the ANL analyses of phases 13A and 13B/1 and includes preliminary results for the later assemblies of phase 13B. The data were compiled primarily for discussions at the Third Jupiter Analysis Meeting to be held at ANL-West between September 11th and 14th, 1984.

9820 **(HEDL-SA—3211-FP) Overview of core designs and requirements/criteria for core restraint systems.** Sutherland, W.H. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76FF02170. 13p. (CONF-8410199—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003008.

From IAEA IWGFR specialists meeting on predictions and experience of core; South Manchester, UK (22 Sep 2517).

The requirements and lifetime criteria for the design of a Liquid Metal Fast Breeder Reactor (LMFBR) Core Restraint System are presented. A discussion of the three types of core restraint systems used in LMFBR core design is given. Details of the core restraint system selected for FFTF are presented and the reasons for this selection given. Structural analysis procedures being used to manage the FFTF assembly irradiations are discussed. Efforts that are ongoing to validate the calculational methods and lifetime criteria are presented.

9821 **(HEDL-SA—3213-FP) Calculation methods for core distortions and mechanical behavior.** Sutherland, W.H. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76FF02170. 43p. (CONF-8410199—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85002999.

From IAEA IWGFR specialists meeting on predictions and experience of core; South Manchester, UK (22 Sep 2517).

This paper describes ABADAN, a general purpose, nonlinear, multi-dimensional finite element structural analyses computer code developed for the express purpose of solving large nonlinear problems as typified by the Liquid Metal Fast Breeder Reactor (LMFBR) Core Restraint System design problem. All of the structural modeling features inherent in a general purpose finite element code and required to adequately model an LMFBR core restraint system are demonstrated. Typical results for a radial row and a sixty degree sector model of FFTF are presented. The sixty degree sector results are interpreted in terms of the design criteria that the core restraint system must satisfy. Extensions and adaptations of these modeling techniques to different core restraint design concepts can be readily achieved. 27 figures.

9822 (IWGFR—42, pp 5-23) **Development of fast reactors in France.** Vautrey, L. Sep 1982. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780224. (CONF-8203112—).

From 15. annual meeting of the IAEA internationnal working group on fast reactors; Obninsk, USSR (30 Mar 1982).

Only minor changes were introduced in the French nuclear programme by the new government in 1981. The operating conditions of Rapsodie were very satisfactory up to January 1982. After a leak in the double primary jacket (nitrogen circuit) the reactor was shut down for investigations. Phenix is continuing to operate smoothly. Construction of Super Phenix (Creys Malville power plant) is proceeding normally though with some delay. The studies for the future (after Creys Malville) are following their way both for the Project 1500 (Super Phenix 2) and for the specific plants of the fuel cycle. Research and development are largely directed toward Super Phenix 1 needs and the prospects of Super Phenix 2. International cooperation remains very intensive. The financial resources devoted to the development of fast reactors are globally stable. Including fuel cycle and safety (but excluding the Phenix operation) about 1300 million francs will be devoted to fast reactors by the C.E.A. in 1982. Separate abstracts were prepared for the various papers presented at the conference.

9823 (IWGFR—42, pp 24-61) **Status of the fast breeder reactor development in the Federal Republic of Germany, Belgium and the Netherlands.** Hueper, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Sep 1982. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780224. (CONF-8203112—).

From 15. annual meeting of the IAEA internationnal working group on fast reactors; Obninsk, USSR (30 Mar 1982).

In 1967 and 1968 the Federal Republic of Germany, the Kingdom of Belgium and the Kingdom of the Netherlands ("DeBeNe") agreed to develop, in a joint program, breeder reactors to the point of commercial maturity. The following research organizations take part in this effort: Kernforschungszentrum Karlsruhe (KfK); INTERATOM, Bergisch Gladbach; ALKEM, Wolfgang near Hanau; SCK/CEN, Mol; Belgonucleaire, Brussels; ECN, Petten; TNO, Apeldoorn; NERATOOM, The Hague. The three German institutions mentioned above have been interrelated since 1977 by the Entwicklungsgemeinschaft (EG) Schneller Brueter. Between KfK, INTERATOM, and the French Commissariat a l'Energie Atomique, contracts were concluded in 1977 about close cooperation in the fast breeder field, with association of the Belgian and Dutch partners. The results of research and development activities carried out by the DeBeNe partners in 1981 have been compiled in this report. The report begins with a short survey of the fast reactor plants, followed by an R and D summary. The bulk of the report gives more detailed information about those plants and about results reported by the Working Groups of the R and D Program Working Committee of the Fast Breeder Project. In an additional chapter a survey is given of international cooperation.

9824 (IWGFR—42, pp 61-67) **Review of fast reactor activities in India.** Paranjpe, S.R. Sep 1982. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780224. (CONF-8203112—).

From 15. annual meeting of the IAEA internationnal working group on fast reactors; Obninsk, USSR (30 Mar 1982).

A review of fast reactor activities in India is introduced. One stage of construction of the Fast Breeder Test Reactor (FBTR) and design studies for 500MWe Prototype Fast Breeder Reactor (PFBR) are briefly summarized. The emphasis is on fast reactor physics, materials studies, radiochemistry, and the safety and fuel reprocessing programme.

9825 (IWGFR—42, pp 68-75) **Review of the Italian fast reactor programme.** Bruzzi, L.; Pierantoni, F. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy)). Sep 1982. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780224. (CONF-8203112—).

From 15. annual meeting of the IAEA internationnal working group on fast reactors; Obninsk, USSR (30 Mar 1982).

A review of the Italian Fast Reactor Programme is given. All the activities regarding the PEC reactor, namely design work, construction, work on site, testing and licensing procedures are summarized. The Italian industry also participates in the construction of Creys-Malville (Super Phenix 1) power station; the share of this participation is about 35%. The components, for which there is considerable involvement of Italian industry, are shown in a figure in this report. A research and development programme in the field of fast breeder reactors over many years has been developed in the framework of the CEA-CNEN Collaboration Agreement. The Italian contribution to this programme is reviewed.

9826 (IWGFR—42, pp 76-111) **Review of fast reactor program in Japan.** Matsuno, Y. Sep 1982. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780224. (CONF-8203112—).

From 15. annual meeting of the IAEA internationnal working group on fast reactors; Obninsk, USSR (30 Mar 1982).

The fast breeder reactor development project in Japan will be continued this fiscal year, from April 1982 through March 1983, at a similar scale of effort both in budget and personnel to those of the fiscal year of 1981. The 1982 year budget for R and D work and for construction of a prototype fast breeder reactor MONJU is approximately 20 and 27 billion yen respectively, excluding wages for the personnel of the Power Reactor and Nuclear Fuel Development Corporation, PNC. Concerning the experimental fast reactor JOYO, power increase from 50 MWt to 75 MWt was made in July 1979 and six operational cycles at 75 MWt were completed in December 1981. With respect to the prototype reactor MONJU, progress toward construction has been made and an environmental impact statement of the reactor was approved by the authorities concerned, and the licensing of the first step was completed at the end of 1981. Preliminary design studies of a large LMFBR are being made by PNC and also by utilities. A design study being conducted by PNC is on a 1000 MWe plant of loop type by extrapolating the technology to be developed by the time of commissioning of MONJU. A group of utilities is conducting a similar study, but covering somewhat wider range of parameters and options of design. In the future, those design efforts will be combined as a single design effort, when a major effort for developing a large demonstration reactor will be initiated .

9827 (IWGFR—42, pp 111-135) **Review of the UK fast reactor programme.** Smith, R.D. (UKAEA Risley Nuclear Power Development Establishment). Sep 1982. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780224. (CONF-8203112—).

From 15. annual meeting of the IAEA internationnal working group on fast reactors; Obninsk, USSR (30 Mar 1982).

A review of the United Kingdom Fast Reactor Programme is introduced. Operational experience with the Prototype Fast Reactor (PFR) is briefly summarized. The design concept of the Commercial Demonstration Fast Reactor (CDFR) is given in some detail. The emphasis is on materials development, chemical engineering/sodium technology, fuel reprocessing and fuel cycle, engineering component development and reactor safety.

9828 (IWGFR—42, pp 136-142) **Fast breeder reactor development in the United States of America.** Horton, K.E. (USDOE, Washington, DC). Sep 1982. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780224. (CONF-8203112—).

From 15. annual meeting of the IAEA internationnal working group on fast reactors; Obninsk, USSR (30 Mar 1982).

Development of the Liquid Metal Fast Breeder Reactor (LMFBR) remains as a high priority activity of the US Department of Energy (USDOE). In the past year, primary efforts supported by USDOE have included continued design, procurement, and preconstruction activities associated with the 375 MWe Clinch River Breeder Reactor Plant (CRBRP), advanced conceptual design of a Large Developmental Plant (LDP), operation of the 400 MWt Fast Flux Test Facility (FFTF), and a Base Technology program providing direct support to these projects as well as the development of generic breeder reactor technology. These activities will continue in the coming year, with some reorientation and consolidation in accordance with Administration policy of reducing federal expenditures and encouraging the involvement of private industry. As a particular example, the LDP activities will be re-focused on supporting private sector efforts to reach a decision on committing to proceed with a large LMFBR demonstration plant. The federal role in the breeder reactor program will be confined to the conduct of necessary research, development and demonstration such that the potential benefits of the breeder can be exploited through private industry at a venture risk level that is consistent with normal business practice.

9829 (IWGFR—42, pp 143-150) **Status of fast reactor activities in the USSR.** Inyutin, E.I.; Khodarev, Eh.A. Sep 1982. (In Russian). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780224. (CONF-8203112—).

From 15. annual meeting of the IAEA internationnal working group on fast reactors; Obninsk, USSR (30 Mar 1982).

A Review of Fast Breeder Reactor Activities in the USSR is given on March 1982 including the BR-10 reactor reconstruction, the results of BOR-60, BN-350 and BN-600 reactors operation, brief information on BN-600 and BN-1600 LMFBR's development and also research and development activities in the field of Fast Breeder Reactors.

9830 (IWGFR—42, pp 151-155) **Review of fast reactor activities in Switzerland.** Wydler, P. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Sep 1982. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780224. (CONF-8203112—).

From 15. annual meeting of the IAEA internationnal working group on fast reactors; Obninsk, USSR (30 Mar 1982).

Fast breeder research and development in Switzerland is concentrated at EIR. Some basic studies of the materials properties of sodium have been conducted at the Institute of Reactor Technology, this being an integral part of the Swiss Federal Institute of Technology in Zuerich. The activities are organized into two projects: a Fast Breeder Project, which includes LMFBR safety and thermohydraulics, and a Fuel Development Project. The present objectives of the safety activities at EIR are threefold: (1) to satisfy the interests of the Federal authorities, (2) to prepare for questions relating to possible future licensing procedures for fast reactors in Switzerland, and (3) to contribute data and results to international safety studies. After 15 years, the GCFR thermohydraulics programme was brought to an end. Within this programme fuel element design codes had been developed and validated using experimental data of high quality. Since 1968 the Fuel Development Project has been developing sphere-pac mixed carbide fuel. Test fuel pins have been irradiated in the SAPHIR reactor at EIR and in foreign reactors. Post-irradiation examination and evaluation of the performance of the pins are carried out in the EIR hot cells. Active collaboration is maintained with several foreign organizations.

9831 **(IWGFR—42) Status of national programmes on fast breeder reactors. Fifteenth annual meeting, Obninsk, USSR, 30 March-2 April 1982.** (International Atomic Energy Agency, Vienna (Austria). International Working Group on Fast Reactors). Sep 1982. 161p. (CONF-8203112—). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780224.

From 15. annual meeting of the IAEA internationnal working group on fast reactors; Obninsk, USSR (30 Mar 1982).

A separate abstract was prepared for each paper presented. (HDR)

9832 (IWGFR—47, pp 5-22) **Development of fast reactors in France - February 1982 to February 1983.** Vautrey, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jul 1983. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780225. (CONF-8304148—).

From 16. annual meeting of international working group on fast reactors - status of national programmes on fast breeder reactors; Vienna, Austria (12 Apr 1983).

The report gives a general review of the development of fast reactors in France from February 1982 to February 1983, that is, the achievements of the last 12 months in what concerns Rapsodie, Phenix, Super Phenix 1 (the plant of Creys Malville), the studies of the project 1500 (Super Phenix 2) and the perspectives of the future. The essential points are the following: (1) The French electronuclear program actually follows the one defined by the Government in the fall of 1981. (2) The decision to definitely stop Rapsodie was taken last October. Some final experiments related to safety will be performed before the ultimate shutdown of the reactor. (3) The operating of Phenix has been disturbed by four leaks in the steam generator. The consequences were minimal. One proceeds successively to the change of the reheating systems on the three circuits. (4) The construction of the Creys Malville power plant is proceeding normally. (5) The studies for after Creys Malville follow their way: studies of the Project 1500 (Super Phenix 2) and of the fuel cycle installations. (6) Research and development, particularly oriented towards the needs of Super Phenix 1 and the perspectives of Super Phenix 2, keeps at a constant level. (7) International cooperation keeps a very important place. (8) The financial and personnel resources remain stable: about 1500 million francs for 1983, including the studies on the fuel cycle and safety, and excluding the operation of Phenix.

9833 (IWGFR—47, pp 22-42) **Status of fast breeder reactor development in the Federal Republic of Germany, Belgium and Netherlands - February 1983.** Hueper, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Jul 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780225. (CONF-8304148—).

From 16. annual meeting of international working group on fast reactors - status of national programmes on fast breeder reactors; Vienna, Austria (12 Apr 1983).

In 1967 and 1968 the Federal Republic of Germany, the Kingdom of Belgium and the Kingdom of the Netherlands ("DeBeNe") agreed to develop breeder reactors in a joint program. The following research organizations have taken part in this effort: Kernforschungszentrum Karlsruhe (KfK); INTERATOM, Bergisch Gladbach; ALKEM, Wolfgang near Hanau; SCK/CEN, Mol; Belgonucleaire, Brussels; ECN, Petten; TNO, Apeldoorn; NERATOOM, The Hague. The three German institutions mentioned above have been connected since 1977 in the Entwicklungsgemeinschaft (EG) Schneller Brueter. Kfk, INTERATOM, and the French Commissariat a l'Energie Atomique entered into contracts in 1977 about close cooperation in the fast breeder field, to which the Belgian and Dutch partners acceded. The results of activities carried out by the DeBeNe partners in 1982 have been compiled in this report. The report begins with a survey of the fast reactor plants and the political background, followed by an R and D summary. In an additional chapter, a survey is given of international cooperation in 1982.

9834 (IWGFR—47, pp 43-68) **Review of the United Kingdom fast reactor program - March 1983.** Smith, R.D. (UKAEA Risley Nuclear Power Development Establishment). Jul 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780225. (CONF-8304148—).

From 16. annual meeting of international working group on fast reactors - status of national programmes on fast breeder reactors; Vienna, Austria (12 Apr 1983).

A review of the United Kingdom Fast Reactor Programme was given in March 1983. Operational experience with the Prototype Fast Reactor (PFR) is briefly summarized. The design concept of the Commercial Demonstration Fast Reactor (CDFR), including design codes, engineering components, materials and fuels development, chemical engineering/sodium technology, safety and reactor performance, is reviewed. The problems of PFR and CDFR fuel reprocessing are also discussed.

9835 (IWGFR—47, pp 69-75) **Review of fast reactor activities in India (1982-83).** Paranjpe, S.R. (Reactor Research Centre, Kalpakkam (India)). Jul 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780225. (CONF-8304148—).

From 16. annual meeting of international working group on fast reactors - status of national programmes on fast breeder reactors; Vienna, Austria (12 Apr 1983).

A review of fast reactor activities in India in 1982-1983 is given. One stage of construction of Fast Breeder Test Reactor (FBTR) is briefly described. The emphasis is on design studies for the 500 MWe Prototype Fast Breeder Reactor (PFBR). The main features of this design are introduced.

9836 (IWGFR—47, pp 76-88) **Status of fast reactor activities in the USSR - April 1983.** Inyutin, E.I.; Khodarev, Eh.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Jul 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780225. (CONF-8304148—).

From 16. annual meeting of international working group on fast reactors - status of national programmes on fast breeder reactors; Vienna, Austria (12 Apr 1983).

A review of fast breeder reactor activities in the USSR was given in April 1983, including the BR-10 reactor reconstruction, the operation experience of BOR-60, BN-350 and BN-600 reactors, and the status of the BN-800 and BN-1600 reactors. A comparison of technical and economical characteristics of fast and thermal reactors is made. Theoretical, experimental and applied studies in the field of fast breeder reactors are briefly summarized.

9837 (IWGFR—47, pp 88-93) **Review of the Italian fast reactor programme.** Bruzzi, L.; Pierantoni, F. (Fast Reactor Dept., ENEA, Bologna (Italy)). Jul 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780225. (CONF-8304148—).

From 16. annual meeting of international working group on fast reactors - status of national programmes on fast breeder reactors; Vienna, Austria (12 Apr 1983).

A review of the Italian Fast Reactor Programme is introduced. The emphasis is on the status of the PEC reactor and Italian activities in the framework of ENEA co-ordinated research and development programmes in the field of FBRs.

9838 (IWGFR—47, pp 94-135) **Review of fast reactor program in Japan - April 1983.** Matsuno, Y. (Power Reactor and Nuclear Fuel Development Corp., Higashi, Ibaraki (Japan)). Jul 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780225. (CONF-8304148—).

From 16. annual meeting of international working group on fast reactors - status of national programmes on fast breeder reactors; Vienna, Austria (12 Apr 1983).

The fast breeder reactor development project in Japan has been in progress during the past twelve months and will be continued in the next fiscal year, from April 1983 through March 1984, at a similar scale of effort both in budget and personnel to those of the fiscal year of 1982. Concerning the experimental fast reactor, JOYO, all the scheduled testings and operations were completed by the end of 1981 and from the beginning of 1982 the change-out work from Mark-I core to Mark-II core has been continued for 11 months. The initial criticality on the Mark-II core was achieved on 22 Nov., 1982 and after 3 months of low power physics tests the reactor power was raised up to 100% (100 MWt) in the middle of March 1983. With respect to the prototype reactor MONJU, progress toward construction has been made and the licensing of the second step will be completed in the first half of 1983. Preliminary design studies of large LMFBR are being made by PNC and also by utilities. A design study being conducted by PNC is on a 1000 MWe plant of loop type by extrapolating the technology to be developed by the time of commissioning of MONJU. A group of utilities is conducting a similar study, but covering somewhat wider range of parameters and options of design. In the future, those design efforts will be combined as a single design effort, when a major effort for developing a large demonstration reactor will be initiated.

9839 (IWGFR—47, pp 136-141) **Review of fast reactor activities in Switzerland.** Wydler, P. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jul 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780225. (CONF-8304148—).

From 16. annual meeting of international working group on fast reactors - status of national programmes on fast breeder reactors; Vienna, Austria (12 Apr 1983).

As a result of the current political situation the Swiss nuclear energy programmes are heavily biased towards the backend of the fuel cycle and only a low priority is being given to research related to advanced reactor concepts. Under these circumstances, the fact that in 1983 the fast breeder activities were allocated a budget increase of 8% (3% after accounting for inflation) was noted with satisfaction by the people concerned. Since Switzerland does not intend to develop its own fast reactor, the available modest funds of 5.8 million Swiss Francs can be concentrated effectively on a few carefully selected activities. These presently comprise topics in the field of LMFBR safety and a development programme for advanced fuels.

9840 (IWGFR—47, pp 141-150) **Status of fast breeder reactor development in the United States of America.** Horton, K.E. (Department of Energy, Washington, DC (USA)). Jul 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780225. (CONF-8304148—).

From 16. annual meeting of international working group on fast reactors - status of national programmes on fast breeder reactors; Vienna, Austria (12 Apr 1983).

The goal of the United States Liquid Metal Fast Breeder Reactor (LMFBR) program is to develop the technology to the point that the private sector can deploy a safe, economic breeder reactor. The LMFBR will provide virtually inexhaustible supplies of electrical energy for the long term and will provide additional confidence to LWR nuclear deployment in the near term. The LMFBR program consists of a streamlined research and development effort focussing on those actions needed to enable private sector financing of industrial deployment including plant demonstration and technology efforts in reactor fuels, components, materials, physics, and safety.

9841 (IWGFR—47, pp 151) **Role of the Nuclear Energy Agency in the area of fast reactors.** Silvennoinen, P. (Nuclear Energy Agency, 75 - Paris (France)). Jul 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780225. (CONF-8304148—).

From 16. annual meeting of international working group on fast reactors - status of national programmes on fast breeder reactors; Vienna, Austria (12 Apr 1983).

9842 (IWGFR—47, pp 151-155) **Commission of the European Communities review of fast reactor activities - March 1983.** Balz, W. (Commission of the European Communities, Brussels (Belgium)). Jul 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780225. (CONF-8304148—).

From 16. annual meeting of international working group on fast reactors - status of national programmes on fast breeder reactors; Vienna, Austria (12 Apr 1983).

The activities of the Commission of the European Communities in the field of fast reactors fall into two categories: coordination and harmonisation, and research.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

9843 (AI-AEC-Memo—12824) **Structural analysis of the SNAP-8 developmental reactor fuel element cladding.** Dalcher, A.W. (Atomics International Div., Canoga Park, CA (USA)). 15 Apr 1969. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number TI85004476.

Primary, secondary, and thermal stresses were calculated and evaluated for the SNAP-8 developmental reactor fuel element cladding. The effects of fabrication and assembly stresses, as well as test and operational stresses were included in the analysis. With the assumption that fuel-swelling-induced stresses are nil, the analytical results indicate that the cladding assembly is structurally adequate for the proposed operation.

9844 (LA-UR—84-2651) **Irradiation effects on fuels for space reactors.** Ranken, W.A.; Cronenberg, A.W. (Los Alamos National Lab., NM (USA); Engineering Science and Analysis, Idaho Falls, ID (USA)). 1984. Contract W-7405-ENG-36. 38p. (CONF-840113—10). NTIS, PC A03/MF A01; GPO Dep. File Number DE84016460.

From Symposium on space nuclear power systems; Albuquerque, NM, USA (10 Jan 1984).

A review of irradiation-induced swelling and gas release experience is presented here for the three principal fuels UO_2, UC, and UN. The primary advantage of UC and UN over UO_2 is higher thermal conductivity and attendant lower fuel temperature at equivalent pellet diameter and power density, while UO_2 offers the distinct benefit of well-known irradiation performance. Irradiation test results indicate that at equivalent burnup, temperature, and porosity conditions, UC experiences higher swelling than UO_2 or UN. Fission gas swelling becomes important at fuel temperatures above 1320 K for UC, and at somewhat higher temperatures for UO_2 and UN. Evidence exists that at equivalent fuel temperatures and burnups, high density UO_2 and UN experience comparable swelling behavior; however, differences in thermal conductivity influence overall irradiation performance. The low conductivity of UO_2 results in higher thermal gradients which contribute to fuel microcracking and gas release. As a result UO_2 exhibits higher fractional gas release than UN, at least or burnups up to about 3%.

9845 (NAA-SR-TDR—12495) **Effect of S8DR chromium diffusion treatment on the creep rupture properties of processed Hastelloy-N tubing.** Allaria, G.G. (Atomics International Div., Canoga Park, CA (USA)). 3 Jun 1967. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004475.

Process development personnel have been seeking means of improving the (after thermal exposure) adhesion of the S8DR ceramic coating to chromized Hastelloy N tubing. This effort has led to the incorporation of an elevated temperature chromium diffusion treatment prior to the application of the ceramic coating. This report describes the results of tests performed to ascertain the influence of the additional thermal treatment on the 1400°F creep-rupture properties of S8DR tubing.

9846 (NAA-SR-TDR—12577) **Post-irradiation examination of in-pile stress-rupture specimens (ORR S-2 and ORR S-3).** Johnson, L.L. (Atomics International, Canoga Park, CA (USA)). 29 Sep 1967. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004470.

Hastelloy-N fuel cladding tube specimens were stress-rupture-tested in-pile at the Oak Ridge National Laboratory. Two cladding heats were tested at 1400°F; hoop stresses ranged from 8000 psi to 26,000 psi. The tubes were then shipped to the Atomics International Hot Laboratory where cladding visual examination, dimensional measurement, and metallographic analysis were performed. Average cladding creep ductility was 1.2%. Cladding failures were intergranular, with some secondary cracking noted. Both cladding ductility and rupture life were reduced by irradiation.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 2107009818, 9911, 9912, 9913, 9914, 9938, 9940

9847 (NUREG—0540-Vol.6-No.9) **Title List of Documents Made Publicly Available, September 1-30, 1984. Volume 6, No. 9.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Nov 1984. 513p. NTIS, PC A22/MF A01 - GPO. File Number TI85900712.

This monthly publication contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes docketed material associated with civilian nuclear power plants and other uses of ra-

dioactive materials and nondocketed mateial received and generated by NRC pertinent to its role as a regulatory agency. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index.

9848 (NUREG—0750-Vol.20-No.3) Nuclear Regulatory Commission issuances. Volume 20, No. 3. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Sep 1984. 264p. NTIS, PC A12/MF A01 - GPO*. File Number TI85900677.

This report includes the issuances received during this period from the Commission, the Atomic Safety and Licensing Appeal Boards, the Atomic Safety and Licensing Boards, the Administrative Law Judge, the Directors' Decision, and the Denials of Petitions for Rulemaking.

2108 Economics

9849 (DOE/SR/00952—T11) Module 11, Part I. Nuclear fuel cycle economics. Part II. Net energy model of nuclear power. Final report. Brehm, R.; Reynolds, R.S. (Arizona Univ., Tucson (USA); Mississippi State Univ., Mississippi State (USA)). Dec 1981. Contract AS09-76SR00952. 134p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85004186.

The primary objective of Part I of this module is to provide a reasonably complete but concise explanation of, and instructional guide into, contemporary nuclear reactor fuel cycle cost analysis. The terminology, principles, and practices of this field of analysis are presented under the premise that this is an instructional guide and not a treatise on each and every possible financial detail or option which might enter into such a cost analysis. A secondary objective is to provide the means for carrying out representative cost calculations and the opportunity for interpreting the results. To this purpose computer codes are included in the appendices of this module. One of the objectives of Part II of this module was to introduce the reader to the concept of net energy analysis and to present a practical model that could be used in the net energy analysis of a nuclear power plant. The model described is capable of combining the engineering, monetary, and environmental characteristics of a nuclear energy system into a common energy baseline. However, the model user should be aware of the sensitivity of the energy coefficient to changes in the fuel cycle as well as to the errors that may be introduced by the assumptions made.

2109 Process Heat Reactors

9850 The gas-cooled Li_2O moderator/breeder canister blanket for fusion-synfuels. Werner, R.W.; Hoffman, M.A. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA 94550). *Nuclear Technology/Fusion;* **4**: No. 2, 1067-1072(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A new integrated power and breeding blanket is described. The blanket incorporates features that make it suitable for synthetic fuel production. It is matched to the thermal and electrical requirements of the General Atomic water-splitting process for producing hydrogen. The fusion reaction is the Tandem Mirror Reactor (TMR) using Mirror Advanced Reactor Study (MARS) physics. The canister blanket is a high temperature, pressure balanced, crossflow heat exchanger contained within a low activity, independently cooled, moderate temperature, first wall structural envelope. The canister uses Li_2O as the moderator/breeder and helium as the coolant. "In situ" tritium control, combined with slip stream processing and self-healing permeation barriers, assures a hydrogen product essentially free of tritium. The blanket is particularly adapted to synfuels production but is equally useful for electricity production or co-generation.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 22010010281, 10549, 10573, 10574, 10575

9851 (BNL—51778, pp 265-304) **Decay heat data needs.** Yoshida, T.; Akiyama, M.; Matumoto, Z.; Katakura, J.; Nakasima, R. (NAIG Nuclear Research Lab., Kawasaki, Japan). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Recent accumulation of decay data remarkably decreased the number of data unknown fission product nuclides whose contributions are non-negligible in the fission product decay heat. There still exist, however, persistent needs for decay data of short-lived nuclides. Nowadays we are much more interested in the quality of the measured decay data than in the 1970's, mainly because the average decay energies anti E/sub β/ and anti E/sub γ/ derived from incomplete decay data may lead to a large systematic error in decay heat calculations. In this respect the existing decay data are critically examined and the desired direction of the future measurement is discussed in this review. Further, intercomparisons among various measurements and calculations of the decay heat are performed in order to shed light on the remaining unresolved discrepancies. These comparisons lead to the needs for the critical reexamination of the existing decay heat data.

9852 (CTA-IEAV-NT—012/83) Adaptation of the Flange-II (71-1 version) computer code to process data from ENDF/B-IV. Queiroz Bogado Leite, S. de; Chalhoub, E.S.; Cunha Menezes Filho, A. da. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 1983. 23p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703428.

A number of modifications has been made in FLANGE-II in order to produce data from ENDF/B-IV tapes for use in thermal spectrum calculations. Included in the analysis is a procedure to compute Legendre cross sections from tabulated distribution functions in the CM system as well as minor changes made to the code improve its output options.

9853 (GRS-A—644) Experiments on criticality carried out from 1975 till 1980. Heinicke, W.; Tischer, A.; Weber, W.J. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Nov 1981. 32p. (In German). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.).

The report on hand includes the experiments on criticality published from 1975 till 1980. About 90 experiments with the most important related data are listed. They are capable of being called up, with the data base system KRITEXP, by 14 different descriptors or printed in any arrangement or order. This is the basis for a global or purposeful verification of the calculating method for criticality safety. The proof of reliability of the calculations for the criticality analysis are immediately relevant for the licencing procedure under atomic law for all plants of the nuclear fuel cycle where nuclear fuels are handled. Since no criticality experiments are being carried out in the Federal Republic of Germany, the data collection on hand will help to fill this gap with regard to the assessment of experiments carried out in other countries.

9854 (IPEN-Pub—50) Finite element response matrix method. Nakata, H.; Martin, W.R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Feb 1983. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703432.

A new technique is developed with an alternative formulation of the response matrix method implemented with the finite element scheme. Two types of response matrices are generated from the Galerkin solution to the weak form of the diffusion equation subject to an arbitrary current and source. The piecewise polynomials are defined in two levels, the first for the local (assembly) calcu-

lations and the second for the global (core) response matrix calculations. This finite element response matrix technique was tested in two 2-dimensional test problems, 2D-IAEA benchmark problem and Biblis benchmark problem, with satisfatory results. The computational time, whereas the current code is not extensively optimized, is of the same order of the well estabilished coarse mesh codes. Furthermore, the application of the finite element technique in an alternative formulation of response matrix method permits the method to easily incorporate additional capabilities such as treatment of spatially dependent cross-sections, arbitrary geometrical configurations, and high heterogeneous assemblies.

9855 **(LA—10189-PR) Radiation transport. Progress report, April 1-December 31, 1983.** O'Dell, R.D. (Los Alamos National Lab., NM (USA)). Oct 1984. Contract W-7405-ENG-36. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85005194.

Research and development progress in radiation transport by the Los Alamos National Laboratory's Group X-6 for the last nine months of CY 83 is reported. Included are unclassified tasks in the areas of Fission Reactor Neutronics, Deterministic Transport Methods, Monte Carlo Radiation Transport, and Cross Sections and Physics.

9856 **(NIIAR—20(585)) Spectral properties of the multigroup diffusion conventionally critical problem.** Makin, R.S.; Shikhov, S.B. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1983. 27p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE84703433.

Spectral properties (spectrum nature, smoothness of eigenfunctions, their completeness and convergence conditions in the Hilbert space) of the multigroup diffusion conventionally critical model of a nuclear reactor are investigated. Stated are the completeness of the system of eigen- and joined vectors of the problem as related to the fission neutron sources, the conditions for summability of the expansions in series by the Abel method of the order of $\alpha >= 2$ as well as the existance of the Bary basis in some particular cases.

9857 (UTNL-R—0122, pp 23-37) **Measurement of thermal neutron spectra using LINAC in Japan Atomic Energy Research Institute (JAERI).** Akino, Fujiyoshi (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1982. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780068.

In Report of the Technical REsearch Committee in time of flight experiments, 1980 and 1981.

The exact grasp of thermal neutron spectra in a core region is very important for obtaining accurate thermal neutron group constants in the calculation for the nuclear design of a reactor core. For the accurate grasp of thermal neutron spectra, the capability of thermal neutron spectra to describe the moderator cross-sections for thermal neutron scattering is a key factor. Accordingly, 0 deg angular thermal neutron spectra were measured by the time of flight (TOF) method using the JAERI LINAC as a pulsed neutron source, for light water system added with Cd and In, high temperature graphite system added with boron, and light water-natural uranium heterogeneous multiplication system among the reactor moderators of light water or graphite systems. First, the equations to give the time of flight and neutron flux by TOF method were analyzed, and several corrections were investigated, such as those for detector efficiency, background, the transmission coefficient of air and the Al window of a flight tube, mean emission time of neutrons, and the distortion effect of re-entrant hole on thermal neutron spectra. Then, the experimental system, results and calculation were reported for the experiments on the above three moderator systems. Finally, the measurement of fast neutron spectra in natural uranium system and that of the efficiency of a ^{6}Li glass scintillator detector are described.

9858 (UTNL-R—0122, pp 38-52) **Measurement and analysis of fast neutron spectra in reactor materials by time-of-flight method.** Hayashi, Shuhei; Kimura, Itsuro; Kobayashi, Shohei; Yamamoto, Shuji (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Nishihara, Hiroshi. Feb 1982. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780068.

In Report of the Technical Research Committee in time of flight experiments, 1980 and 1981.

The LINAC-TOF experiments have been done to measure the neutron energy spectra in the assemblies of reactor materials. The sample materials to be measured were iron, stainless steel, aluminum, nickel, zirconium, thorium, and lithium. The shapes of assemblies were piles (rectangular parallelopiped, sphere, and polyhedron) and slab. A photoneutron target was set at the center of the pile assemblies. Each assembly has an electron injection hole and a re-entrant hole. In case of a slab, a photo neutron target was placed at the outside of the slab. Neutrons were generated by using an electron linear accelerator (LINAC). The length of the flight path was 20 m. The neutron detectors were a Li-6 glass scintillator and a B-10 vaseline-NaI(Tl) scintillator. The spatial distributions of neutrons in the piles were measured by the foil activation method. The neutron transport calculation was performed, and the evaluation of group constants was made.

9859 (UTNL-R—0122, pp 117-120) **Evaluation of group constants by measuring neutron spectra.** Hayashi, Shuhei; Yamamoto, Shuji; Kobayashi, Shohei (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Feb 1982. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780068.

In Report of the Technical Research Committee in time of flight experiments, 1980 and 1981.

The measurement of neutron spectra in a reactor assembly can evaluate group constants by comparing them with the calculation based on the theory. In this report, the evaluation of the group constants of an iron-lead assembly of Yayoi is reported. The measurement was made by the LINAC-TOF method. The angle-dependent neutron spectra were measured by a Li-6 glass scintillator. The iron assembly was set in the Yayoi lead intermediate neutron column. The distance from the re-entrant hole of the iron assembly to the detector was 27.975 m. Electron beam was injected into a lead target at the center of iron assembly, and generated photo-neutrons. The background measurement was made by scattering method and a resonance filter method. The spatial distribution in the iron assembly was measured by nickel foils. The evaluation of group constants in low energy region became possible.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 2202009858, 9933, 9942

9860 **(ANL—84-82) Avoiding leakage flow-induced vibration by a tube-in-tube slip joint.** Mulcahy, T.M. (Argonne National Lab., IL (USA)). Oct 1984. Contract W-31-109-ENG-38. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004829.

Parameters and operating conditions (a stability map) were determined for which a specific slip-joint design did not cause self-excited lateral vibration of the two cantilevered, telescoping tubes forming the joint. The joint design featured a localized annular constriction. Flowrate, modal damping, tube engagement length, and eccentric positioning were among the parameters tested. Interestingly, all self-excited vibrations could be avoided by following a simple design rule: place constrictions only at the downstream end of the annular region between the tubes. Also, overall modal damping decreased with increased flowrate, at least initially, for upstream constrictions while the damping increased for downstream constrictions.

9861 (BNL-NUREG—35629) Testing of nuclear grade lubricants and their effects on A540 B24 and A193 B7 bolting materials. Czajkowski, C.J. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 18p. (CONF-850311—2). NTIS, PC A02/MF A01 - GPO. File Number TI85004208.

From National Association of Corrosion Engineers annual meeting and materials performance and corrosion show; Boston, MA, USA (25 Mar 1985).

An investigation was performed on eleven commonly used lubricants by the nuclear power industry. The investigation included EDS analysis of the lubricants, notched-tensile constant extension rate testing of bolting materials with the lubricants, frictional testing of the lubricants and weight loss testing of a bonded solid film lubricant. The report generally concludes that there is a significant amount of variance in the mechanical properties of common bolting materials; that MoS_2 can hydrolyze to form H_2S at 100°C and cause stress corrosion cracking (SCC) of bolting materials, and that the use of copper-containing lubricants can be potentially detrimental to high strength steels in an aqueous environment. Additionally, the testing of various lubricants disclosed that some lubricants contain potentially detrimental elements (e.g. S, Sb) which can promote SCC of the common bolting materials. One of the most significant findings of this report is the observation that both A193 B7 and A540 B24 bolting materials are susceptible to transgranular stress corrosion cracking in demineralized H_2O at 280°C in notched tensile tests.

9862 (CONF-8409109—7) In situ calibration of nuclear plant resistance thermometers using Johnson noise. Draft. Blalock, T.V.; Roberts, M.J.; Shepard, R.L. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004434.

From Industrial temperature measurement symposium; Knoxville, TN, USA (10 Sep 1984).

Methods have been demonstrated in operating nuclear plants for the in situ calibration of resistance thermometers with agreement between measured noise temperatures and dc calibration temperatures well within these required by the plant. A comparison of the results of Johnson noise power testing results and uncertainties, the requirements for accuracy, and PRT calibration tolerances is shown. The methods use Johnson noise measurements and provide an absolute calibration independent of the prior dc calibration. The methods include techniques for characterization of the installed extension cables and the quantitative determination of induced EMI and its effect on the calibration. The techniques are applicable to ordinary 4-wire platinum resistance thermometers operating over their entire design temperature range and to extension cables of about 100 ft length. Careful attention needs to be paid to the choice or cables, location of terminal boxes, and grounding and shielding practices in the plant installation to achieve comparable results.

9863 (FEI—1491) Calculation and graphical representation of nuclear reactor core maps and NPP lay-out. Bykov, S.V.; Isakova, L.Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703429.

The SETKA and ALLES computer codes developed for calculation and graphical representation of reactor core maps with allocation of movable control maps and NPP integral lay-outs are described in brief. The programs are written in FORTRAN for BESM-6 computers. The SETKA computer code permits to calculate all assembly centres, to determine coordinates of all control rod channel centres, to find the core size taking into account the assemblies displaced by the control rod channels, to combine into circular zones and calculate geometrical dimensions of circular absorbing zones simulating control rods, to determine the number and type of nonstandard cells near the core and control rod channel boundaries; to obtain graphical representation of the core map. In the ALLES computer code the algorithms for calculation of integral lay-out of the NPP primary circuit equipment are realized. The input data are the following: the core size, protection thicknesses between the core and heat exchangers and pumps, dimensions and types of pumps, heat exchangers, pipelines, equipment lay-out, vessel thicknesses and protection heights above the reactor, dimensions of chambers and filters . Taking all this into account the NPP lay-out is calculated and graphically represented in two projections.

9864 (FEI—1493) On the coolant mixing optimization in wire-wrapped rod bundles. Yur'ev, Yu.S.; Prokhorova, N.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 23p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703434.

A problem of optimum coolent mixing in wire-wrapped rod bundles is analytically studied. A complex approach to determination of optimum characteristics of spiral rod fins in case of the fixed characteristics of the circulating pumps has shown that there exists the optimum in the spiral fin slope. At too "large" rappinq pitch, convective mixing, flow rate equalization and heat transfer from "hot spots" are not enough. At too "small" wrapping pitch hydraulic zone resistance increases and flow rate decreases resulting in the "hot spot" temperature rise. Using a fast reactor fuel assembly, it is shown that the optimum turn number of spiral winding in the core length is 2. The maximum gain in "hot spot" temperature decreasing is equal to several percent. The formulae and analytical expressions derived herein permit to find optimum finning parameters taking into account temperature and hydraulic requirements to the reactor core operating conditions.

9865 (SVF—144) Power plant noise and vibration. Pumps - a selected bibliography. Nilsson, N.Aa; Westerberg, G. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Oct 1983. 114p. (In Swedish, English). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750204.

This bibliography will serve as a first stage in a study of noise and vibration from pumps with special reference to power plant applications. The aim of this work has been to provide a survey of the field. The material has though been selected and limited to such references judged valuable in solving power plant problems. This selection has been done so that the overview and enough related side information are maintained in order that new ideas and new technology for noise reduction can be identified and implemented. The bibliography contains four parts. 1. A short overview of the information gathered. 2. A classification system especially produced for this bibliography. 3. A listing of reference numbers according to the classification system. 4. An author organized file of numbered references with classification codes. The initiative to this R and D program comes from the Swedish Thermal Engineering Research Association, through its reference group on Noise in Power Plants. The authors accept responsibility for the contents. The members of the reference group have, however, contributed their views.

9866 (SVF—145) Power plant noise and vibration. Fans and blowers - a selected bibliography. Nilsson, N.Aa.; Westerberg, G. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Oct 1983. 127p. (In English, Swedish). NTIS (US Sales Only), PC A07/MF A01. File Number DE85750205.

This bibliography will serve as a first stage in a study on noise and vibration from fans and blowers with special reference to power plant applications. The aim of this work has been to provide a survey of the field. The material has though been selected and limited to such references that could be judged valuable in solving power plant problems. This selection has been done so that the overview and enough related side information are maintained in order that new ideas and new technology for noise reduction can be identified and implemented. The bibliography contains four parts: 1. A short overview of the information gathered. 2. A classification system especially produced for this bibliography. 3. A listing of reference numbers according to the classification system. 4. An author organized file of numbered references with classification codes. The initiative to this R and D program comes from the Swedish Thermal Engineering Research Association, through its reference group on Noise in power plants. The authors accept responsibility for the contents. The members of the reference group have, however, contributed their views.

2203 Fuel Elements

9867 (DOE/ET/34215—36) Fuel Performance Improvement Program. Progress report, April 1983-March 1984. Patterson, J.F. (Exxon Nuclear Co., Inc., Richland, WA (USA)). 5 Dec 1984. Contract AC02-76ET34215. 50p. (XN-NF—84-99). NTIS (US Sales Only), PC A03/MF A01; 1; GPO Dep. File Number DE85005097.

Objectives of FPIP are to develop commercially viable LWR fuel designs which are highly resistant to pellet-cladding interaction (PCI) failures and to demonstrate the satisfactory irradiation performance of the selected designs. Destructive examination of an annular pellet, graphite-coated cladding, pressurized rod was completed at Harwell. This rod had been base irradiated in the Halden Boiling Water Reactor, but had never been ramped. Destructive examination of eleven FPIP rods previously ramped in the Studsvik reactor began at EIR in Switzerland. A third poolside fuel examination was completed at the Big Rock Point Reactor along with the transfer of 32 FPIP fuel rods from discharged fuel assemblies into two other host assemblies for further irradiation. Twenty segmented FPIP rodlets were loaded into a shipping cask at the Big Rock Point Reactor for transport to the Studsvik reactor for a second ramp series.

9868 (HEDL-SA—3125) Advances in continuous gamma-ray spectrometry and applications. Gold, R.; McNeece, J.P.; Kaiser, B.J. (Hanford Engineering Development Lab., Richland, WA (USA); General Electric Co., Wilmington, NC (USA)). Jul 1984. Contract AC06-76FF02170. 16p. (CONF-840902—17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003018.

From 5. ASTM-Euratom symposium on reactor dosimetry; Geesthacht, F.R. Germany (24 Sep 1984).

Recent advances and applications in continuous Compton recoil gamma-ray spectrometry are described. Applications of continuous gamma-ray spectrometry are presented for: (1) Characterization of light water reactor (LWR) pressures vessel (PV) environments. (2) Assessment of fuel distributions for Three Mile Island Unit 2 (TMI-2) reactor recovery. (3) Measurement of LWR-PV-neutron exposure. The latest improvements attained with the Janus probe, a special in-situ configuration of Si(Li) detectors, are presented. The status of current efforts to extend the domain of applicability of this method beyond 3 MeV is discussed with emphasis on recent work carried out with Si(Li) detectors of much larger volume.

9869 (PNL-SA—9582) Ex-reactor determination of thermal gap conductance between uranium dioxide and Zircaloy-4. Stage II: high gas pressure. Garnier, J.E.; Begej, S. (Pacific Northwest Lab., Richland, WA (USA)). May 1981. Contract AC06-76RL01830. 31p. (CONF-8106164—6). NTIS, PC A03/MF A01. File Number TI85004755.

From National Bureau of Standards joint conferences: 8. symposium on thermophysical properties; 17. thermal conductivity conference; 8; Gaithersburg, MD, USA (15 Jun 1981).

A study of thermal gap conductance (H/sub g/) between depleted UO_2 and Zircaloy-4 was performed using a transient laser pulse technique under varying conditions of gas pressure (0.1 to 7 MPa), temperature (283 to 673K), gas composition (He, Ar, and He-Xe, He-Ar mixtures) and gap width (5.9 and 23.1 μm). At fixed gap width, H/sub g/ is dependent upon these variables with the following behavior observed: H/sub g/ exhibits a strong dependence on gas pressure over the range 0.1 to 1 MPa; H/sub g/ decreases with increasing xenon or argon gas concentration at any given temperature and gas pressure; H/sub g/ increases with argon gas pressure over the range 1 to 7 MPa corresponding to the reported increase in argon gas thermal conductivity; and, at a gap of 5.9 μm, H_2 exhibits a pronounced hump at gas pressures between 0.1 and 2 MPa for He and He-Xe (90:10) gas mixtures progressively diminishing with decreasing temperature, xenon or argon concentration; and/or increased gap width separation. Comparison of results to predictions based on an ideal expression for thermal gap conductance is made. Gaseous mechanisms of heat transfer under narrow gap conditions are discussed.

9870 (UFRJ-COPPE-PEN—122) PATE - a computer code for the calculation of temperature distribution in cylindrical fuel rods. Silva Neto, A.J. da; Roberty, N.C.; Carmo, E.G.D. do. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). Aug 1983. 60p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE84703435.

An analytical solution for the temperature profile in the fuel cladding is presented, having the coolant temperature as boundary conditions and using a first-order polynomial for the zircalloy thermal conductivity. The temperature profile in the fuel pellet is determined solving an algebraic equation by iterative methods.

2204 Control Systems

9871 (EPRI-NP—3779) Automated maintenance in nuclear power plants. Final report. Bartilson, B.M.; Kok, K.D.; Renner, G.F.; Rosen, K.L. (Battelle Columbus Labs., OH (USA)). Nov 1984. 143p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $14.50. File Number TI85920108.

Robotics technology has developed to where it can provide consistently reliable performance of well-defined tasks. Although nuclear power plant maintenance tasks are characteristically unique, there are some common subtasks which have the consistency required for robots. Several maintenance activities were selected for further study. Concepts for robotic devices and rough scenarios for their use were developed and analyzed for their effect on maintenance costs. The results of the analysis, which was performed using conservative estimates and procedures, indicate cost savings ranging from $100,000 to $1 M in net present value per robot. Projected purchase prices for the robots were less than $200,000. Although the robot concepts used commercially available technology, they are unlike any products either in use or widely required. Robot manufacturers are concentrating on mainstream applications in production, and are unlikely to develop such specialized products. The potential for cost savings indicates that developments should be funded by the nuclear industry.

9872 (NUREG/CR—4017) Interim criteria for the use of programmable digital devices in safety and control systems. Adams, D.M.; Svoboda, J.M. (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1984. Contract AC07-76ID01570. 36p. (EGG—2348). NTIS, PC A03/MF A01 - GPO. File Number TI85005153.

Proposed criteria for the application of stored program, digital computers in commercial nuclear power plants is presented. This report emphasizes recommendations for the design of computer systems and recommends a method for the regulatory review of computer system designs. More restrictive requirements are made for protection systems than control systems or other plant computer systems. In making these recommendations, the study team reviewed current regulations, past Nuclear Regulatory Commission reviews of computer systems, the work done by other government agencies, and the work done by many other countries. Results of this study provide a classification of systems, a recommended design method, and a specification of design issues to be resolved during the design and development of digital computer systems. Also included is a recommendation of subject areas that need further research activity. This report is part of a larger program to research computer system design issues, to develop design criteria (hardware and software) for Safety Parameter Display Systems, to research software quality assurance, to provide a comparative risk assessment of digital technology, and to develop electrical isolation criteria.

2205 Environmental Aspects

9873 (NUREG—0837-Vol.4-No.2) NRC TLD Direct Radiation Monitoring Network. Progress report, April-June 1984. Volume 4, No. 2. Jang, J.; Kramaric, M.; Cohen, L. (Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I). Nov 1984. 147p. NTIS, PC A07/MF A01 - GPO*. File Number TI85900737.

This report provides the status and results of the NRC Thermoluminescent Dosimeter (TLD) Direct Radiation Monitoring Network. It presents the radiation levels measured in the vicinity of NRC licensed facility sites throughout the country for the second quarter of 1984.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 2206009590, 9815, 9819, 9820, 9901, 9930, 10134, 10289

9874 **(DOE/ER/04014—14) University of Florida Training Reactor. Annual progress report, September 1, 1983-August 31, 1984.** Vernetson, W.G. (Florida Univ., Gainesville (USA). Dept. of Nuclear Engineering Sciences). Nov 1984. Contract AC05-76ER04014. 65p. (ORO—4014-14). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004464.

The University of Florida Training Reactor's overall utilization for the past reporting year has increased dramatically compared to previous years, even exceeding the levels of utilization characteristic of the early 1970's in some areas such as energy generation. Indeed, the total energy generation (kWh) for this reporting year is at the highest level ever and represents an increase of over 300% over the 1982-1983 reporting year which itself had an increase of 50% over the 1981-1982 reporting year.

9875 **(EGG/LTR—144-8-Suppl.2) Stress evaluation of modified rake assemblies with positive lock devices for cap screws.** Finicle, D.P. (EG and G Idaho, Inc., Idaho Falls (USA)). 23 Jan 1979. Contract AC07-76ID01570. 28p. (EGG-RE-E—77-130-Suppl.2). NTIS, PC A03. File Number DE85004837.

A revised stress analysis of the Modified Rake assembly with positive lock devices on the cap screws has been completed. This is an alternate design option to the welded locking cups, which are causing distortion problems during welding. The positive locking devices were analyzed to the requirements of Section III of the ASME Code (1977). The locking devices and welds were found to be structurally adequate.

9876 (HMI-B—411, pp 72-73) **Experimental potentialities of the reactor PIK.** Yerykalov, A.N.; Kondurov, I.A.; Konoplev, K.A.; Krasotsky, Z.K.; Petrov, Yu.V.; Sumbaev, O.I.; Trunov, V.A. 1984. Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). (CONF-840874—).

From Symposium on neutron scattering; Berlin, F.R. Germany (9 Aug 1984).

Published in summary form only.

9877 (JINR-D—3,4-82-704, pp 292-303) **On-line measurement center of the JINR Laboratory of Neutron Physics. Present status and prospects of development.** Zhukov, G.P. 1982. (In Russian). NTIS (US Sales Only), PC A23/MF A01. File Number DE84780542. (CONF-820658—).

From 4. international school on neutron physics; Dubna, USSR (8 Jun 1982).

On-line measurement center of the JINR Laboratory of neutron physics intended for performing investigations at the IBR-30 and the IBR-2 pulse reactors is described. The PDP-11/70 computer is used as a central processor. The electronic equipment is realized in the CAMAC standard. The central computer terminal network is described. The methods of organizing computer spectrometric information storage are shown. For initiation of experiment programs the technological complex SANPO is developed as well as DUM (dual memory) interpreter which permits to perform simultaneously two experiments using one computer. For realizing electrical intermachine communications, units which enable to perform data acquisition and transmission by a serial code under asynchronous regime. Intermachine communications software is developed towards the creation of the computer network oriented to the problems of atomation of scientific researches and called SONET (Scientific Oriented Network), prospects of development of on-line measurement center are described.

9878 **(NUREG/CR—0169-Vol.22) LOFT experimental measurements uncertainty analysis. Volume XXII. Fission product detection system instruments recorded on the DAVDS.** Evans, R.P. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1984. Contract AC07-76ID01570. 26p. (EGG—2037). NTIS, PC A03/MF A01 - GPO. File Number TI85005151.

An uncertainty analysis was performed for the Loss-of-Fluid Test Fission Product Instruments recorded on the Data Acquisition and Visual Display System in order to document the accuracy of these channels under steady state operating conditions. In addition, an uncertainty analysis was performed for certain temperature and pressure measurement channels excluding their recording system.

9879 **(NUREG/CR—4031-Vol.1) Neutron spectral characterization for the Fifth Heavy Section Steel Technology (HSST) irradiation series: simulator experiments.** Baldwin, C.A.; Kam, F.B.K.; Stallmann, F.W. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 58p. (ORNL/TM—9423/V1). NTIS, PC A04/MF A01 - GPO. File Number TI85004418.

Three neutron dosimetry experiments were performed at the Oak Ridge Research Reactor Poolside Facility to study the feasibility of using the facility for the Fifth Nuclear Regulatory Commission Heavy Section Steel Technology Metallurgical Irradiations. The first two experiments revealed the original experimental configuration to be inadequate because the fluence rates estimated from the measured saturation activities were too low. In response to this, the core loading was changed and the entire experimental facility was moved closer to the core. A third experiment was performed and the resulting saturation activities and fluence rate estimates increased by approximately 40% at the points of interest. The latter fluence rate estimates were considered satisfactory, so no further changes were necessary. This report describes the three characterization experiments in detail and gives all measurement results. An analysis of the results with regard to consistency and measurement uncertainty is also presented. It is shown that the experimental results are consistent within uncertainty bounds.

9880 **(SRDP-R—104) Safeguards sealing systems for Zebra.** Ingram, G.; Jamieson, G.R. (UKAEA Atomic Energy Research Establishment, Harwell. Safeguards R and D Project). 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703470.

A relatively simple design has been produced for safeguards seals to be applied throughout the fuel containing areas at Zebra. It is based on the use of wire seals and regular Inspector surveillance. The application of the system would allow an Inspector to establish to a high degree of confidence that significant quantities of fuel had not been diverted during an intensive experimental programme. It would add about 5% to the time required for experiments, and careful planning would reduce this value. The inspection effort required to witness element movements during the experimental programme would average about 2 hours per day, with a further 2 hours spent each week on NDA of the fuel exposed. The Safeguards Inspector would be required to spend about 25% of his time in the reactor area and would have ample time to deal with the relatively small number of fuel movements taking place in the storage area and with his duties elsewhere in the plant. During a core change, full-time inspection effort would be required for about 6 weeks each year.

9881 (UTNL-R—0122, pp 19-22) **Progress and present status for TOF experiments in Yayoi nuclear facility of University of Tokyo.** Nakazawa, Masaharu (Tokyo Univ., Tokai, Ibaraki (Japan). Nuclear Engineering Research Lab.). Feb 1982. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780068.

In Report of the Technical Research Committee in time of flight experiments, 1980 and 1981.

The LINAC of Yayoi nuclear facility, University of Tokyo, has been mainly operated for the purpose of the interlinking operation with the reactor and pico-second pulse radiolysis. The TOF (time of flight) experiments were carried out from May to June and from September to October in 1979 as the fast neutron spectrome-

try for a lead target graphite system. Those experimental results surely showed that the whole system used for the experiments was valid. The TOF experiments for LiF and graphite systems were also performed in the neutron engineering laboratory in the building for the fundamental experiments for nuclear fusion reactor blanket design located in the same nuclear facility site. The features of this facility in investigating its use and application on the basis of experimental experience in the first fiscal year, are that neutron generation is presently limited in a lead octagonal column, and the rate of facility utilization per year is within 8 weeks (substantially 4 to 5 weeks). In graphite system spectrometry, the correction to mean emission time becomes very large in a low energy region. It should be regarded as an expansion of moderation time spectrometry rather than the correction to mean emission time. On the contrary, the utilization of such a lead system cleverly using its advantage is extremely effective. The application to the standard field for intermediate neutrons is an example.

9882 (UTNL-R—0122, pp 108-111) **Measurement of characteristics of intermediate neutron column.** Yamauchi, Toyoaki; Yoshii, Koji; Okamura, Kazuo (Tokyo Univ., Tokai, Ibaraki (Japan). Nuclear Engineering Research Lab.). Feb 1982. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780068.

In Report of the Technical Research Committee in time of flight experiments, 1980 and 1981.

The reactor Yayoi of the University of Tokyo can be used as a lead modulation type spectrometer. An electron linear accelerator is used for the neutron source. The characteristics of the system was measured. The lead assembly is a 2.5 m wide and 2.5 m height octagonal column. The detectors were a micro BF_3 counter and a micro fission chamber. The time distribution of neutrons at three experimental points was obtained. A time-energy relation was measured by using various filters. The resolving power determined from the 5.19 eV resonance of Ag was 55.9 percent. The effect of neutron leakage and the absorption by iron are important. The amount of leakage was measured and compared with an estimated value from the Fermi's age theory. The agreement between both values was good. The neutron energy spectrum was obtained. The fission cross sections were evaluated by a fission chamber, and comparison with the group constants was carried out. It was found that the Yayoi intermediate neutron column could be used as a lead modulation spectrometer.

2207 Plutonium And Isotope Production Reactors

9883 (NIIAR—13(578)) **Equipment for the neutron activation analysis in the SM-2 reactor horizontal channel.** Ivanov, O.I.; Pavlov, V.V. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1983. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703451.

An installation for research and mass multielemental neutron-activation analysis of specimens containing inactive, active and fissle materials is described. The installation comprises a transport line with units of loading, unloading and storage of specimens designed on the base of ARS-12, pneumotransport device a 4.8 m long radiation unit, a holding unit for cooling activated specimens, a unit of address storage intended for long-term storage of containers with specimens a detection unit with a high resolution Ge(Li) gamma detector a scintillation NaI-detector with 150x100 mm dimensions for detection of high-energy γ-radiation and a scintillation 63x63 mm NaI-detector for detection of the monitor activity, spectrometric equipment and computer. The installation is mounted on the SM-2 horizontal channel. The maximum thermal neutron flux density is $7x10^{13}$ neutr./(cm^2xs). The integral flux of 1 and 7 MeV neutrons approaches $2x10^{11}$ and 10^{10} neutr./(cm^2xs), respectively.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 2209009868

9884 **(AEEW-M—1958) Data for use in UKAEA PWR plant studies.** Kinnersly, S.R.; Richards, C.G.; O'Mahoney, R. (UKAEA Atomic Energy Establishment, Winfrith). May 1983. 70p. NTIS (US Sales Only), PC A04/MF A01. File Number DE84703439.

Plant data represented by the RETRAN, RELAP4 and TRAC models used at Winfrith for studies of pressurised faults and small and large break loss of coolant accidents for the UK PWR are presented together with comparable data for the Sizewell B design taken from the Pre-Construction Safety Report (PCSR). The main components of the plant are described, and modelling issues, which may affect the interpretation and assessment of the data, and the historical development and use of the models, are outlined. The bulk of the report consists of tables of data with supporting figures and text for all the main items of plant modelled in the Winfrith accident studies. The data presented should be adequate to allow assessments of the Winfrith models and results to be carried out and provide a firm basis for the development of models more representative of the Sizewell B PCSR design.

9885 **(AEEW-M—2060) Dynamic storage and restart facilities in MABEL-2.** Nye, M.T.S. (UKAEA Atomic Energy Establishment, Winfrith). Dec 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703440.

MABEL-2 is a FORTRAN program for calculating clad ballooning in a PWR during a LOCA. Originally written with fixed array storage, the use of the code has been extended by including dynamic storage. The lengths of the arrays in the program are set at execution time, varying from run to run. This allows much greater freedom in the choice of mesh and the size of case run. The use of computer memory is also more efficient. In addition, a restart facility has been included which allows the user to break off and restart execution of the program (once or many times) during a transient. By using this facility, much longer calculations can be run. Should an error in either input data or program become apparent late in a transient, the case need only be re-run from the last dump because some input data can be altered at restart. The use of these new facilities and the coding changes are described.

9886 **(AEEW-R—1543) Ballooning analysis for the Sizewell B PWR using symmetric MABEL calculations.** Sweet, D.W.; Gibson, I.H.; Fell, J. (UKAEA Atomic Energy Establishment, Winfrith). Dec 1982. 78p. NTIS (US Sales Only), PC A05/MF A01. File Number DE84703441.

An analysis of the fuel clad ballooning potential associated with the Sizewell B PWR following a design basis large break cold leg LOCA is described. Calculations employ MABEL-2C code. No allowance has been made for asymmetries in power or geometry, thus precluding any amelioration offered by early clad rupture. Thermal hydraulic data were derived from a TRAC-PD2 best estimate analysis of the LOCA and the work includes a detailed sensitivity study which leads to a correlation between peak clad temperature and clad strain. For the best estimate start of cycle 1 peak rod rating, no loss of coolability is expected within 95 percent confidence limits on peak clad temperature. No loss of coolability is expected either for rods at the design basis peak rod rating. The temperature does not have to be much higher than the 95 percent confidence limit on the best estimate rating or much beyond that of the design basis rating for rod contact and severe blockage to follow. This indicates that to establish a complete safety case the added complexity of pellet eccentricity and rod to rod power variations must be considered.

9887 **(AEEW-R—1595) UKAEA modelling studies of clad ballooning and rupture following loss of coolant in a PWR using MABEL.** Gibson, I.H.; Sweet, D.W.; Fell, J.; Haste, T.J. (UKAEA Atomic Energy Establishment, Winfrith). Dec 1982. 88p. NTIS (US Sales Only), PC A05/MF A01. File Number DE84703442.

In a loss-of-coolant accident (LOCA) and under pessimistic assumptions about ECCS performance, clad temperatures could rise

to 800 deg C to 1200 deg C. At these temperatures and at increased internal pressures, Zircaloy is a very ductile material and can creep to give clad strains of over 100 percent. If this were to happen the coolant passages would be restricted and regions of the fuel bundle could be inadequately cooled. Studies of clad ballooning have been carried out at Winfrith, assuming that pellet and cladding remained concentric, that the positions of the rod centres remained unchanged, and that neighbouring pins behaved in an identical manner. Under these conditions the clad can balloon to the extent of channel closure before empirical Zircaloy rupture criteria are invoked. In this report, the best estimate TRAC calculations on Sizewell B are continued to take into account the effects of pellet eccentricity and other sources of azimuthal temperature gradient. The results are compared with other calculations and the reasons for differences examined. Final sections consider the effects of relative movements between the pellet and cladding and the effects of this on the burst strain.

9888 **(AEEW-R—1624) AEEW comments on the NNC/CEGB LOCA code validation report RX 440-A.** Brittain, I.; Bryce, W.M.; O'Mahoney, R.; Richards, C.G.; Gibson, I.H.; Porter, W.H.L.; Fell, J. (UKAEA Atomic Energy Establishment, Winfrith). Mar 1984. 55p. NTIS (US Sales Only), PC A04/MF A01. File Number DE84703443.

Comments are made on the NNC/CEGB report PWR/RX 440-A, Review of Validation for the ECCS Evaluation Model Codes, by K.T. Routledge, et al, 1982. This set out to review methods and models used in the LOCA safety case for Sizewell B. These methods are embodied in the Evaluation Model Computer codes SATAN-VI, WREFLOOD, WFLASH, LOCTA-IV and COCO. The main application of these codes is the determination of peak clad temperature and overall containment pressure. The comments represent the views of a group which has been involved for a number of years in the development and application of best-estimate methods for LOCA analysis. It is the judgement of this group that, overall, the EM methods can be used to make an acceptable safety case, but there are a number of points of detail still to be resolved.

9889 **(AEEW-R—1692) Probability of containment failure by steam explosion in a PWR.** Briggs, A.J. (UKAEA Atomic Energy Establishment, Winfrith). Dec 1983. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703444.

The study of the risk associated with operation of a PWR includes assessment of severe accidents in which a combination of faults results in melting of the core. Probabilistic methods are used in such assessment, hence it is necessary to estimate the probability of key events. One such event is the occurrence of a large steam explosion when molten core debris slumps into the base of the reactor vessel. This report considers recent information, and recommends an upper limit to the range of probability values for containment failure by steam explosion for risk assessment for a plant such as the proposed Sizewell B station.

9890 **(BNL-NUREG—29813) Potential influence of core/concrete interactions on PWR containment pressurization.** Pratt, W.T.; Gasser, R.D.; Bari, R.A. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 7p. (CONF-811103—35). NTIS, PC A02/MF A01 - GPO. File Number TI85003647.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

For certain postulated accidents beyond the present design basis for LWRs it has been shown that the potential exists to fail the containment building as a result of extensive core debris-concrete interactions. The MARCH code was developed at BCL to analyse the response of a LWR to core meltdown accidents. MARCH has been found to be nonconservative with regard to predicting core-concrete interactions in the following areas: (1) energy is not conserved, i.e. heat transfer from the top of the molten core is lost. It is not added to the atmosphere or used to heat-up and degas concrete. (2) MARCH uses INTER to model core-concrete interactions. INTER models only a molten pool attacking concrete. The core materials rapidly freeze; this limits the applicability of the model. This paper removes the above nonconservation in MARCH to more realistically determine the potential for containment pressurization and basemat penetration resulting from extensive core-concrete interactions. Large amounts of combustible gases are also released during core-concrete interactions; however this paper is primarily concerned with the partial pressure exerted by these gases on containment. It therefore considers accidents without the containment heat removal systems (CHRS) operating so that burning of the combustibles is prevented by low oxygen concentration.

9891 **(BNL-NUREG—29835) Analysis of a partial scram event in a typical BWR/4.** Lu, M.S.; Shier, W.; Levine, M.M.; Cerbone, R. (Brookhaven National Lab., Upton, NY (USA)). Jun 1981. Contract AC02-76CH00016. 6p. (CONF-811103—29). NTIS, PC A02/MF A01 - GPO. File Number TI85003650.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

As a result of the partial scram incident at Browns Ferry Unit 3, Brookhaven National Laboratory (BNL) performed an analysis for a Boiling Water Reactor (BWR/4) assuming similar scram failures. The RELAP3B model used for this half scram analysis is based on the RELAP3B model for Peach Bottom 2 power plant.

9892 **(BNL-NUREG—29863) Interfacial heat transfer between overlying liquid layers with gas agitation.** Greene, G.A.; Schwarz, C.E. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 7p. (CONF-811103—23). NTIS, PC A02/MF A01 - GPO. File Number TI85003447.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

Complete meltdown of an LWR core may lead to rapid penetration of the pressure vessel and thermal interaction between core materials and concrete in the reactor cavity in the absence of intervention by engineered reactor safety features. Subsequent core-concrete interactions impact upon containment integrity by containment pressurization, production of combustible gases, and basemat erosion. The CORCON code represents the state of the art calculational tool for calculating the consequences of the attack of molten core materials upon concrete. This paper addresses the phenomenon of heat transfer between immiscible overlying corium layers agitated by gas release from the concrete which is one of the dominant heat transfer processes that needs to be modelled for accurate calculations of core-concrete interactions by CORCON.

9893 **(BNL-NUREG—35236) Information-theoretic approach to uncertainty importance.** Park, C.K.; Bari, R.A. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 7p. (CONF-850206—7). NTIS, PC A02/MF A01 - GPO; GPO Dep. File Number TI85001230.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

A method is presented for importance analysis in probabilistic risk assessments (PRA) for which the results of interest are characterized by full uncertainty distributions and not just point estimates. The method is based on information theory in which entropy is a measure of uncertainty of a probability density function. We define the relative uncertainty importance between two events as the ratio of the two exponents of the entropies. For the log-normal and log-uniform distributions the importance measure is comprised of the median (central tendency) and of the logarithm of the error factor (uncertainty). Thus, if accident sequences are ranked this way, and the error factors are not all equal, then a different rank order would result than if the sequences were ranked by the central tendency measure alone. As an illustration, the relative importance of internal events and in-plant fires was computed on the basis of existing PRA results.

9894 **(BNL-NUREG—35288) Development of generic floor response spectra for equipment qualification for seismic loads.** Curreri, J.R.; Costantino, C.J. (Brookhaven National Lab., Upton, NY (USA)). Oct 1984. Contract AC02-76CH00016. 9p. (CONF-841075—7). NTIS, PC A02/MF A01 - GPO. File Number TI85003516.

From International thermal hydraulics and plant operations topical meeting; Taipei, Taiwan (22 Oct 1984).

A generic floor response spectra has been developed for use in the qualification of electrical and mechanical equipment in operating nuclear power plants. Actual PWR and BWR - Mark I structural models were used as representative of a class of structures. For each model, the stiffness properties were varied, with the same mass, so as to extend the fundamental base structure natural frequency from 2 cps to 36 cps. This resulted in fundamental mode coupled natural frequencies as low as 0.86 cps and as high as 30 cps. The characteristics of 1000 floor response spectra were studied to determine the generic spectra. A procedure for its application to any operating plant has been established. The procedure uses as much or as little information that currently exists at the plant relating to the question of equipment qualification. A generic floor response spectra is proposed for the top level of a generic structure. Reduction factors are applied to the peak acceleration for equipment at lower levels.

9895 **(BNL-NUREG—35441) Occupational dose reduction developments and data collected at nuclear power plants.** Dionne, B.J.; Baum, J.W. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 16p. (CONF-8410142—66). NTIS, PC A02/MF A01 - GPO. File Number TI85004157.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Occupational dose reduction developments and data collected at nuclear power plants have been described. Written descriptions of repetitive high dose jobs, their collective dose equivalent ranges and list of dose reduction techniques will aid in reducing collective dose equivalents from these dose-reduction targets. Knowing which components contribute to high maintenance or repair dose will aid in reducing routine maintenance collective dose equivalents. The radwaste dose reduction improvements will aid in reducing radwaste operations collective dose equivalent and reduce the number of radwaste workers who exceed their administrative dose limits. The identification and rating of managers' and workers' ALARA incentives will provide the basis for recommendations to improve dose reduction incentives. Lastly, the identification and rating of the key components of an ALARA program will aid in the development and coordination of the nuclear station ALARA programs.

9896 **(CNEN-DR—118/83) Almod 3W version 2: the application in the safety analysis of Angra 1 final safety analysis report (FSAR).** Camargo, C.T.M. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). May 1983. 50p. (In Portuguese). (GNT—02/83). NTIS (US Sales Only), PC A03/MF A01. File Number DE84703445.

Some calculations for transient analysis of Angra 1 power reactors with Almod 3 version 2 computer codes are presented. Those calculations are done for control rod draw accidents.

9897 **(CONF-830609—72) Downward penetration of hot UO_2 into basalt concrete.** Farhadieh, R.; Purviance, R.; Carlson, N. (Argonne National Lab., IL (USA)). 1983. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005017.

From ANS annual meeting; Detroit, MI, USA (12 Jun 1983).

Following a postulated meltdown accident, the integrity of containment building structural material under attack by hot molten core debris and the safeguard of environment against radiological releases constitutes the final line of defense in PAHR safety assessment. Such assessment requires a good knowledge of UO_2/interaction and penetration with different types of concrete. The present study focuses on the phenomena associated with core debris interaction/penetration with substrate basalt concrete.

9898 **(CONF-841017—9) Temperature noise characteristics of pressurized water reactors.** Sweeney, F.J.; Upadhyaya, B.R. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). 1984. Contract AC05-84OR21400. 11p. NTIS, PC A02. File Number DE85002475.

From Specialists' meeting on reactor noise - SMORN IV; Dijon, France (15 Oct 1984).

The core exit temperature noise RMS is linearly related to the core ΔT at a commercial PWR and LOFT. Test loop observations indicate that this linear behavior becomes nonlinear with blockages, boiling, or power skews. The linear neutron flux to temperature noise phase behavior is indicative of a pure time delay process, which has been shown to be related to coolant flow velocity in the core. Therefore, temperature noise could provide a valuable diagnostic tool for the detection of coolant blockages, boiling, and sensor malfunction under both normal and accident conditions in a PWR.

9899 **(CONF-850206—1) Methods and computer codes for probabilistic sensitivity and uncertainty analysis.** Vaurio, J.K. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84015818.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

This paper describes the methods and applications experience with two computer codes that are now available from the National Energy Software Center at Argonne National Laboratory. The purpose of the SCREEN code is to identify a group of most important input variables of a code that has many (tens, hundreds) input variables with uncertainties, and do this without relying on judgment or exhaustive sensitivity studies. Purpose of the PROSA-2 code is to propagate uncertainties and calculate the distributions of interesting output variable(s) of a safety analysis code using response surface techniques, based on the same runs used for screening. Several applications are discussed, but the codes are generic, not tailored to any specific safety application code. They are compatible in terms of input/output requirements but also independent of each other, e.g., PROSA-2 can be used without first using SCREEN if a set of important input variables has first been selected by other methods. Also, although SCREEN can select cases to be run (by random sampling), a user can select cases by other methods if he so prefers, and still use the rest of SCREEN for identifying important input variables.

9900 **(CONF-850206—4) Development of a Reliability Program approach to assuring operational nuclear safety.** Mueller, C.J.; Bezella, W.A. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85000078.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

A Reliability Program (RP) model based on proven reliability techniques used in other high technology industries is being formulated for potential application in the nuclear power industry. Research findings are discussed. The reliability methods employed under NASA and military direction, commercial airline and related FAA programs were surveyed with several reliability concepts (e.g., quantitative reliability goals, reliability centered maintenance) appearing to be directly transferable. Other tasks in the RP development effort involved the benchmarking and evaluation of the existing nuclear regulations and practices relevant to safety/reliability integration. A review of current risk-dominant issues was also conducted using results from existing probabilistic risk assessment studies. The ongoing RP development tasks have concentrated on defining a RP for the operating phase of a nuclear plant's lifecycle. The RP approach incorporates safety systems risk/reliability analysis and performance monitoring activities with dedicated tasks that integrate these activities with operating, surveillance, and maintenance of the plant. The detection, root-cause evaluation and before-the-fact correction of incipient or actual systems failures as a mechanism for maintaining plant safety is a major objective of the RP.

9901 **(CONF-850206—5) Common cause analysis of the TREAT upgrade reactor protection system.** Page, R.J.; Kamis, G.J.; Marbach, R.A.; Mueller, C.J. (Argonne National Lab., IL (USA)). Sep 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002101.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

A triply redundant reactor scram system (RSS) has been designed for the upgraded TREAT facility. The independent failures reliability goal for the RSS is $<10^{-9}$ failures per demand. An independent failures analysis indicated that this goal would be met. In addition, however, recognizing that in heavily redundant systems common-cause failures dominate, a common cause analysis of the TREAT upgrade RSS was done. The objective was to identify those common-cause initiators which could affect the functioning of the RSS, and to subsequently modify the design of the RSS so that the effect was minimized. A number of common-cause initiators were identified which were capable of defeating the triple redundancy feature of the reactor scram system. By means of a systematic analysis of the effect these initiators could have on the system, it was possible to identify seven necessary design and procedural modifications that would greatly reduce the probability of the reactor being run while the RSS was in a faulted condition.

9902 **(CONF-850206—6) Probabilistic risk analysis of HCDA scenarios in a pool-type breeder reactor.** Page, R.J.; Mueller, C.J.; Rothman, A.B.; Chasanov, M.; Sevy, R.; Marchaterre, J.F.; Froehle, P.J.; Pedersen, D.R.; Farhadieh, R. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000092.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

One potential design for the future generation of nuclear reactors is that of the breeder reactor. As with present-day reactors there is the necessity for demonstrating that such a reactor will be operable with very small risk to the public. As a result, a probabilistic risk analysis (PRA) will be a valuable tool in the design of future nuclear plants. This paper presents a risk analysis performed to evaluate hypothetical core disruptive accidents (HCDAs) in a large, pool-type LMFBR, and how it was used to evaluate the reduction in risk brought about by the addition of various safety-related design options. It was shown that the base design met the NRC risk guidelines with some margin, and that a design option featuring emergency cooling of the reactor vessel greatly reduced the risk.

9903 **(CONF-850206—8) Reliability assurance program for operational emergency ac power system.** Heineman, J.B.; Ragland, W.A.; Mueller, C.J. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002554.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

A comprehensive review of emergency ac power systems in nuclear generating plants (the vast majority of these plants contain redundant diesel generator systems) delineates several operational areas that can be improved by instituting a reliability assurance program (RAP), which initially upgrades the diesel generator performance and provides for ongoing monitoring and maintenance based upon alert levels.

9904 **(CONF-8411128—1) Role of crack arrest in the evaluation of PWR pressure vessel integrity during PTS transients.** Cheverton, R.D.; Ball, D.G. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003063.

From International conference on dynamic fracture mechanics; San Antonio, TX, USA (7 Nov 1984).

The HSST program is investigating flaw behavior in large cylinders and is also obtaining fracture-mechanics-related material properties, while the Integrated Pressurized Thermal-Shock (IPTS) program is primarily concerned with an estimation of the overall frequency of vessel failure and identification of dominant transients and design and operating features contributing thereto for specific nuclear plants. One important component of the IPTS study is a probabilistic fracture-mechanics analysis of the reactor vessel, and a point of particular interest therein is the role of crack arrest in mitigating the consequences of the postulated PTS transients. The HSST program has provided crack-arrest data from small specimens and large thermal- and pressure-loaded cylinders that tend to establish the validity of the crack-arrest concept for application to the PTS problem. Unfortunately, recent results of the IPTS studies indicate that the inclusion of crack arrest in the probabilistic fracture-mechanics model does not substantially influence the calculated frequency of vessel failure. However, there are still significant questions regarding flaw behavior at upper-shelf temperatures, and the HSST program is continuing to pursue this area of uncertainty.

9905 **(EGG-M—14784) Pressurized water reactor transient identification and monitoring technique using reactor coolant pumps.** Adams, J.P.; Bayless, P.D.; Dobbe, C.A.; Fincke, J.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 7p. (CONF-841105—49). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004318.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

The statement that RCP parameters can be used to measure the local fluid density and to identify transient type, have been verified and extended to commercial PWRs using extensive LOFT and test pump data for void fractions up to $\sim$ 0.3. It has been further demonstrated that the local density is a conservative (low) measure of the density of the primary coolant system. An exception to this may exist as indicated by the calculation of commercial PWR operations wherein the average primary system void fraction started to increase prior to that at the RCP inlet. Thus, RCPs can be used to identify the transient type and to monitor the recovery from the transient.

9906 **(EGG-M—18784) RELAP5/MOD2 assessment calculation of Semiscale Test S-UT-8.** Ogden, D.M.; Davis, C.B. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 23p. (CONF-8410142—41). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003411.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

In support of the US Nuclear Regulatory Commission's independent assessment of RELAP5, the Idaho National Engineering Laboratory (INEL) has performed analysis of Semiscale Test S-UT-8 using RELAP5/MOD2. Test S-UT-8, representing a 5% cold leg break, is of interest because an extended core liquid level depression that was related to liquid holdup in the steam generator U-tubes occurred prior to loop seal clearing. Initial subsequent renodalization calculations were performed. Calculation results were compared with experimental data. Assessment of the code's performance relative to the observed test phenomena, including loop seal clearing, steam generator liquid holdup, and core liquid level depression, was performed.

9907 **(EGG-M—19184) Tee/Critical Flow Experiments.** Anderson, J.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 3p. (CONF-8410142—51). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003420.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

This paper provides an overview of the Tee/Critical Flow Experiments that were conducted during the summer of 1984 in the Two-Phase Flow Loop (TPFL). The purpose of the tee/critical flow experiments was to investigate the liquid entrainment/vapor pull-through phenomena of a stratified high-pressure steam-water flow through a tee.

9908 **(EPRI-NP—3774-Vol.1) Concrete containment structural element tests. Volume 1. Half-thickness element tests - description and results. Final report.** Julien, J.T.; Schultz, D.M.; Weinmann, T.L. (Portland Cement Association, Skokie, IL (USA). Construction Technology Labs.). Nov 1984. 98p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $13.00. File Number TI85920116.

Understanding the structural behavior of nuclear reactor containment buildings under extreme internal pressures can lead to more realistic estimates of risk from severe core accidents. This study provides test data on the behavior, under biaxial tensile loads, of large-scale segments of a containment building with reinforced and prestressed concrete designs.

9909 **(EPRI-NP—3774-Vol.3) Concrete containment structural element tests. Volume 3. Liner-plate tests. Final report.** Julien, J.T.; Schultz, D.M.; Weinmann, T.L. (Portland Cement Association, Skokie, IL (USA). Construction Technology Labs.). Nov 1984. 136p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $14.50. File Number TI85920141.

Tension tests of eight half-thickness concrete containment wall elements and four 1/4-in. (6.4-mm) thick isolated steel liner plates were conducted as part of an Electric Power Research Institute (EPRI) program. The objective of the EPRI testing program is to provide a test-verified analytical method for estimating capacities of concrete reactor containment buildings under internal overpressurization from postulated degraded core accidents. The data from the tests reported herein should be useful for benchmarking analytical methods that require modeling of material behavior including concrete cracking and reinforcement/concrete interaction exhibited by the data. General background material concerning rationale for each 1/4-in. (6.4-mm) thick steel plate specimen, loading scenarios and criteria, instrumentation and data acquisition equipment, and results and conclusions are presented.

9910 **(GEND-INF—047) Radionuclide mass balance for the TMI-2 accident: data through 1979 and preliminary assessment of uncertainties.** Davis, R.J.; Tonkay, D.W.; Vissing, E.A.; Nguyen, T.D.; Shawn, L.W.; Goldman, M.I. (NUS Corp., Gaithersburg, MD (USA)). Nov 1984. Contract AC07-76ID01570. 137p. YE07/$5.50; 1; GPO Dep. File Number DE85004314.

A systematic data base of available information needed to calculate mass balances of key radionuclides arising from the Three-Mile Island Unit 2 (TMI-2) accident as a function of time has been assembled. The sample and analysis data represent the likely major sinks except for the solids remaining in the primary system. Surfaces in the primary system are represented only by preliminary data pertaining to cesium deposition on plenum surfaces. TMI-2 component description data are included for the reactor coolant, makeup and purification, and liquid waste systems and the reactor building. The chronology of liquid transfers through the end of 1979 is included. A mass transfer model has been developed. It is concluded that tritium and cesium released into the reactor coolant traveled with the reactor coolant without losses to other phases during transit and storage. The data also suggest that tritium and cesium were not leached from primary solids and surfaces after the accident, although strontium has gradually leached from the primary solids and surfaces over a long period. Much of the iodine transferred to the reactor building sump/basement is suspected of having transferred to surfaces or solids from the sump/basement water and was therefore not found in basement water samples.

9911 **(GRS-A—706) Probabilistic safety assessment.** Hoertner, H.; Schuetz, B. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1982. 73p. (In German). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.).

For the purpose of assessing applicability and informativeness on risk-analysis methods in licencing procedures under atomic law, the choice of instruments for probabilistic analysis, the problems in and experience gained in their application, and the discussion of safety goals with respect to such instruments are of paramount significance. Naturally, such a complex field can only be dealt with step by step, making contribution relative to specific problems. The report on hand shows the essentials of a 'stocktaking' of systems relability studies in the licencing procedure under atomic law and of an American report (NUREG-0739) on 'Quantitative Safety Goals'.

9912 **(GRS-A—761) Probabilistic risk assessment in the German licencing procedure and probabilistic safety goals in the USA.** Hoertner, H.; Linden, J. von. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Apr 1983. 171p. (In German). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.).

The report on hand includes a list of passages in German nuclear regulations and guidelines using probabilistic argumentations. By means of expertises, we try to show the specific interpretation of certain passages in the licencing procedure. One of the focal points of probabilistic argumentation in the licencing procedure may well be the application of criterion 1.1 of the BMI criteria, according to which probabilistic methods are to be used among other for reviewing the safety conception. The expertises thoroughly deal with these problems, with respect to specific incident related reliability analyses. In the USA, the probabilistic safety assessment of nuclear power plants focuses on the execution of probabilistic risk assessment for every single plant. Such risk analyses have already affected decisions concerning licencing. In order to set a standard for the probabilistic safety assessment, suggestions have been made in the USA since 1980 concerning 'safety goals'. Part 2 of this report reflects the present state of safety goals which have been established by NRC.

9913 **(GRS-A—807) Systems reliability analyses and risk analyses for the licencing procedure under atomic law.** Berning, A.; Spindler, H. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jan 1983. 44p. (In German). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.).

For the licencing procedure under atomic law in accordance with Article 7 AtG, the nuclear power plant as a whole needs to be assessed, plus the reliability of systems and plant components that are essential to safety are to be determined with probabilistic methods. This requirement is the consequence of safety criteria for nuclear power plants issued by the Home Department (BMI). Systems reliability studies and risk analyses used in licencing procedures under atomic law are identified. The stress is on licencing decisions, mainly for PWR-type reactors. Reactor Safety Commission (RSK) guidelines, examples of reasoning in legal proceedings and arguments put forth by objectors are also dealt with. Correlations are shown between reliability analyses made by experts and licencing decisions by means of examples.

9914 **(GRS-A—816) Development and application of probabilistic methods in safety assessment in the USA.** Gueldner, W.; Schaefer, H.; Schuetz, B. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Apr 1983. 79p. (In German). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.).

Upon the evaluation and findings concerning the TMI accident, more work has been initiated in the development and application of probabilistic methods for risk assessment of nuclear power plants. This report describes the risk analysis programmes (RSSMAP, IREP, NREP) resulting from such activities, related methods guidelines (manuals IREP, PRA) and correlations with risk analyses (Big Rock Point, Limerick) carried out and the US licencing procedure. Finally, these programmes and methods are opposed to the respective German procedures in comparative evaluations.

9915 **(HEDL-SA—3178-FP) Effect of axial blanket central hole size on internal fuel motion.** Smith, D.E. (Hanford Engineering Development Lab., Richland, WA (USA)). 10 Jul 1984. Contract AC06-76FF02170. 6p. (CONF-841105—37). NTIS, PC A02MF A01; 1; GPO Dep. File Number DE85002996.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

It has been postulated that the use of annular fuel provides an inherent safety shutdown mechanism during hypothetical LMFBR accidents by providing a pathway for molten fuel to be ejected from the active core region to the fission gas plenum. Previous work evaluating internal fuel motion for whole-core, transient

overpower accident cases has been unable to demonstrate the viability of the mechanism for ramp rate cases of $3/s with 3$ total reactivity insertion and below. Continued work reported here has identified an axial blanket internal hole size design variation which does significantly improve the viability of internal fuel motion to act as an inherent safety shutdown mechanism. The size of axial blanket central hole studied was 0.356 cm diameter (large), double the 0.178 cm diameter (small) used previously. Three combinations of annular axial blankets and fission gas plena have been analyzed with the large size central hole: top annular blanket and plenum, bottom annular blanket and plenum, and both top and bottom (dual) annular blankets and plena. The base case assumed a 3$/s transient overpower (TOP) accident with a $3 reactivity insertion for a 2550 MWt Large Development Plant (LDP) heterogeneous core design. The cases were analyzed using the coupled MELT-IIIB/FUMO-E code.

9916 **(IAEA-TECDOC—303) Manual on the selection of appropriate quality assurance programmes for items and services of a nuclear power plant.** (International Atomic Energy Agency, Vienna (Austria)). Feb 1984. 105p. NTIS (US Sales Only), PC A06/MF A01. File Number DE84703436.

This manual provides guidance and illustrative examples for devising a system by which applicable quality assurance activities may be selected and applied to items and services in conformance with the requirements of the Code and the guidance of SG-QA 1. The selective application system described herein contains the following elements: (1) Classification of items and services; (2) Grading of quality assurance activities; (3) Correlation of applicable quality assurance activities with items and services; (4) Adaptation of selected quality assurance activities to the unique needs of the items or services; (5) Specifying of applicable quality assurance activities in bid specifications or in a contract. This selective application system is intended to be used by plant systems designers in the classifying of items (structures, components and materials) and related services; and by the organizations designing, manufacturing, installing and operating items or performing support services for such items in the specifying of applicable quality assurance activities that are to be implemented. The parts of the system should be developed to the degree and sophistication necessary for the particular needs of the project or organization.

9917 **(NUREG—0606-Vol.6-No.4) Unresolved safety issues summary: Aqua book. Volume 6, No. 4.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). 16 Nov 1984. 98p. NTIS, PC A05/MF A01 - GPO*. File Number TI85900852.

The unresolved issues summary is designed to provide the management of the Nuclear Commission with a quarterly overview of the progress and plans for completion of generic tasks addressing unresolved safety issues reported to Congress pursuant to section 210 of the Energy Reorganization Act of 1974 as amended. This summary utilizes data collected from the Office of Nuclear Reactor Regulation, Office of Nuclear Regulatory Research, and the National Laboratories and is prepared by the Office of Nuclear Reactor Regulation.

9918 **(NUREG—0787-Suppl.8) Safety Evaluation Report related to the operation of Waterford Steam Electric Station, Unit No. 3 (Docket No. 50-382). Supplement No. 8.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Dec 1984. 98p. NTIS, PC A05/MF A01 - GPO* $4.75. File Number TI85900859.

Supplement 8 to the Safety Evaluation Report for the application filed by Louisiana Power and Light Company for a license to operate the Waterford Steam Electric Station, Unit 3 (Docket No. 50-382), located in St. Charles Parish, Louisiana, has been prepared by the Office of Nuclear Reactor Regulation of the Nuclear Regulatory Commission. The purpose of this supplement is to update the Safety Evaluation Report by providing the staff's evaluation of information submitted by the applicant since the Safety Evaluation Report and its seven previous supplements were issued.

9919 **(NUREG—0954-Suppl.4) Safety evaluation report related to the operation of Catawba Nuclear Station, Units 1 and 2 (Docket Nos. 50-413 and 50-414).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Dec 1984. 218p. NTIS, PC A10/MF A01 - GPO $6.50. File Number TI85900738.

This report supplements the Safety Evaluation Report (NUREG-0954) issued in February 1983 by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission with respect to the application filed by Duke Power Company, North Carolina Municipal Power Agency Number 1, North Carolina Membership Corporation, and Saluda River Electric Cooperative, Inc., as applicants and owners, for licenses to operate the Catawba Nuclear Station, Units 1 and 2 (Docket Nos. 50-413 and 50-414, respectively). The facility is located in York County, South Carolina, approximately 9.6 km (6 mi) north of Rock Hill and adjacent to Lake Wylie. This supplement provides additional information supporting the license for initial criticality and power ascension to full-power opertion for Unit 1.

9920 **(NUREG—1061-Vol.3) Report of the US Nuclear Regulatory Commission Piping Review Committee. Volume 3. Evaluation of potential for pipe breaks.** (Nuclear Regulatory Commission, Washington, DC (USA)). Nov 1984. 206p. NTIS, PC A10/MF A01 - GPO* $6.00. File Number TI85900518.

The Executive Director for Operations (EDO) in establishing the Piping Review Committee concurred in its overall scope that included an evaluation of the potential for pipe breaks. The Pipe Break Task Group has responded to this directive. This report summarizes a review of regulatory documents and contains the Task Group's recommendations for application of the leak-before-break (LBB) approach to the NRC licensing process. The LBB approach means the application of fracture mechanics technology to demonstrate that high energy fluid piping is very unlikely to experience double-ended ruptures or their equivalent as longitudinal or diagonal splits. The Task Group's reommendations and discussion are founded on current and ongoing NRC staff actions as presented in Section 3.0 of this report. Additional more detailed comments and discussion are presented in Section 5.0 and in Appendices A and B. The obvious issues are the reexamination of the large pipe break criteria and the implications of any changes in the criteria as they influence items such as jet loads and pipe whip. The issues have been considered and the Task Group makes the following recommendations.

9921 **(NUREG/CR—2331-Vol.4-No.1) Safety research programs sponsored by Office of Nuclear Regulatory Research. Quarterly progress report, January 1-March 31, 1984. Volume 4, No. 1.** Bari, R.A.; Cerbone, R.J.; Czajkowski, C.J.; Ginsberg, T.; Greene, G.A.; Guppy, J.G.; Hall, R.E.; Luckas, W.J. Jr.; O'Brien, J.N.; Pratt, W.T. (Brookhaven National Lab., Upton, NY (USA)). Aug 1984. Contract AC02-76CH00016. 161p. (BNL-NUREG—51454-Vol.4-No.1). NTIS, PC A08/MF A01 - GPO. File Number TI85003898.

The projects reported are the following: High Temperature Reactor Research, SSC Development, Validation and Application, CRBR Balance of Plant Modeling, Thermal-Hydraulic Reactor Safety Experiments, Development of Plant Analyzer, Code Assessment and Application (Transient and LOCA Analyses), Thermal Reactor Code Development (RAMONA-3B), Calculational Quality Assurance in Support of PTS; Stress Corrosion Cracking of PWR Steam Generator Tubing, Bolting Failure Analysis, Probability Based Load Combinations for Design of Category I Structures, Mechanical Piping Benchmark Problems, Identification of Age-Related Failure Modes; Analysis of Human Error Data for Nuclear Power Plant Safety-Related Events, Human Factors Aspects of Safety/Safeguards Interactions During Routine Reactor Operations and Off-Normal Conditions, Emergency Action Levels, and Protective Action Decision Making.

9922 **(NUREG/CR—3025) High-Pressure Melt Streaming (HIPS) program plan.** Tarbell, W.; Brockmann, J.; Pilch, M. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 206p. (SAND—82-2477). NTIS, PC A10/MF A01 - GPO. File Number TI85003999.

The Zion Probabilistic Safety Study (ZPSS) envisions accident sequences that could lead to failure of the reactor vessel while the primary system is pressurized. The resulting ejection of molten core material into the reactor cavity followed by the blowdown of steam and hydrogen is shown to cause the debris to enter into the containment region. The High Pressure Melt Streaming (HIPS) program has been developed to provide an experimental and analytical investigation of the scenario described above. One-tenth linear scale models of the Zion cavity region will be used to investigate the debris dispersal phenomena. Smaller-scale experiments (SPIT-tests) are also used to study high-velocity jets, jet-water interactions, and 1/20th scale cavity geometries. Both matrices are developed using a factorial design approach. The document describes certain aspects of the ZPSS ex-vessel phenomena, the experimental matrices, test equipment, and instrumentation, and the program's analytical efforts. Preliminary data from SPIT testing are included.

9923 **(NUREG/CR—3195) Analysis of semiscale MOD-2A system UHI/SBLOCA experiments.** Shimeck, D.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1983. Contract AC07-76ID01570. 40p. (EGG—2246). NTIS, PC A03/MF A01 - GPO. File Number TI83011206.

A series of six experiments was conducted in the Semiscale Mod-2A System, a scaled model of a pressurized water reactor (PWR), to investigate the influence of an upper head injection (UHI) emergency core cooling system on system response to small-break loss-of-coolant accidents (SBLOCAs). Three different cold leg break sizes were examined, simulating breaks of 2.5, 5, and 10% of the area of a PWR cold leg pipe. Thermal-hydraulic data on system response without UHI (baseline) and with UHI were obtained for each break area. The data were analyzed in terms of the influence of UHI and the influence of break size. Common SBLOCA signatures for various system parameters are identified. A convenient method of gauging the relative severity of each transient is presented.

9924 **(NUREG/CR—3519) Human error probability estimation using licensee event reports.** Voska, K.J.; O'Brien, J.N. (Brookhaven National Lab., Upton, NY (USA)). Jul 1984. Contract AC02-76CH00016. 114p. (BNL-NUREG—51717). NTIS, PC A06/MF A01 - GPO. File Number TI85003961.

Objective of this report is to present a method for using field data from nuclear power plants to estimate human error probabilities (HEPs). These HEPs are then used in probabilistic risk activities. This method of estimating HEPs is one of four being pursued in NRC-sponsored research. The other three are structured expert judgment, analysis of training simulator data, and performance modeling. The type of field data analyzed in this report is from Licensee Event reports (LERs) which are analyzed using a method specifically developed for that purpose. However, any type of field data or human errors could be analyzed using this method with minor adjustments. This report assesses the practicality, acceptability, and usefulness of estimating HEPs from LERs and comprehensively presents the method for use.

9925 **(NUREG/CR—3521) Hydrogen-burn survival experiments at Fully Instrumented Test Site (FITS).** Richards, E.H.; Aragon, J.J. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 52p. (SAND—83-1715). NTIS, PC A04/MF A01 - GPO. File Number TI85004312.

A series of hydrogen-burn experiments conducted for the Hydrogen-Burn Survival Program is described. The experiments, executed at Sandia National Laboratories' Fully Instrumented Test Site (FITS) facility in Albuquerque, provided data concerning the hydrogen-burn thermal environment as it relates to equipment survivability in nuclear power plants. The test plan, instrumentation, and results are presented, along with a brief discussion of test volume (scale) considerations. Conclusions drawn from the results concern the repeatability of the tests, the suitability of thermocouples for measuring gas temperatures, and the effects of initial hydrogen concentrations and fans on the responses of calorimeters and components. The effect of initial steam concentration on temperature response cannot be determined because of preignition pressure considerations.

9926 **(NUREG/CR—3885-Vol.2) High-temperature gas-cooled reactor safety studies for the Division of Accident Evaluation. Quarterly progress report, April 1-June 30, 1984. Volume 2.** Ball, S.J.; Cleveland, J.C.; Harrington, R.M.; Weber, C.F.; Wilson, J.H. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 24p. (ORNL/TM—9267/V2). NTIS, PC A02/MF A01 - GPO. File Number TI85003266.

Modeling, code development, and accident analysis work on the modular High-Temperature Gas-Cooled Reactor (HTGR) systems concentrated on predictions of core and other system temperature histories for postulated long-term loss of forced circulation accidents both with and without system depressurization. Fission-product (FP) release experiments to investigate vapor pressure and diffusion rates through graphite were continued. Experiments with additional elements were conducted.

9927 **(NUREG/CR—3986) Thermal-hydraulic process modeling in risk analysis: an assessment of the relevant systems, structures, and phenomena.** (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 641p. (SAND—84-1219). NTIS, PC A99/MF A01 - GPO. File Number TI85003989.

The MELCOR project is developing a new generation of risk assessment computer programs for analysis of severe accidents at nuclear power plants. This document details the findings in the thermal-hydraulic areas for PWRs and areas common to both PWRs and BWRs. The study was performed by specialists from each of the various nuclear plant design or analysis areas where thermal-hydraulics is important. The study found that the current level of thermal-hydraulic modeling that exists for performing risk assessments is typified by the modeling in the MARCH code. This level of modeling was found to be inadequate for MELCOR because of inconsistent or nonexistent modeling of important phenomena, particularly invessel phenomena, systems, and structures. Pressurized water reactor modeling was found to be more complete than modeling for boiling water reactor designs, particularly in containment. Finally, although reactor cavity modeling was considered essential for risk assessments, the lack of adequate modeling found for the cavity was identified as a serious impediment to the development of second-generation risk codes.

9928 **(NUREG/CR—3995) Hydrodynamics of countercurrent two phase flow through porous media.** Marshall, J.S.; Dhir, V.K. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Dec 1984. 224p. NTIS, PC A10/MF A01 - GPO* $6.50. File Number TI85900861.

Understanding of the hydrodynamic characteristics and flow limitations of two-phase flow through porous media is necessary to evaluate the coolability of a top flooded nuclear reactor core. In the present work, and analytical and experimental investigation of countercurrent two-phase flow through 80 to 100 cm deep porus layers composed of both uniform size spherical particles (nominal diameters 1 to 19 mm), mixture of these particles, and mixtures of spherical paricles and nonspherical sharps has been performed. The porous layers were formed in a 20-cm dia plexiglass tube. Water and air were used as the test fluids, with superficial velocities ranging from 0 to 19.5 mm/s and 0 to 163 mm/s, respectively. Bed porosity, mean particle diameter, flooding limits, and void fraction and pressure gradient at flooding were investigated. An analytical approach based upon geometrical models was used to derive expressions for porosity and mean particle diameter. An empirical correlation has been found for the flooding data which is slightly different than that found in the literature. The effect of coupling of the overlying liquid layer with the bed and of axial gas injection upon the flooding limit were also studied. Results of these hydrody-

namic investigations were applied to obtain dryout heat flux in bottom and volume heated particulate beds.

9929 **(NUREG/CR—4021) Verification of experimental modal modeling using HDR (Heissdampfreaktor) dynamic test data.** Srinivasan, M.G.; Kot, C.A.; Hsieh, B.J.; Dusing, J.A.; Peterson, E.L. (Argonne National Lab., IL (USA)). Oct 1984. Contract W-31-109-ENG-38. 101p. (ANL—84-25). NTIS, PC A06/MF A01 - GPO. File Number TI85004313.

An attempt to verify the reliability of the experimental modal modeling code, MODAL-PLUS, is described in this report. MODAL-PLUS is capable of synthesizing a modal model of a structure using data from dynamic testing of a structue. The objective was to determine whether a modal model synthesized from one set of test data would be capable of correctly predicting response to a different form of excitation from a different set of data. Recorded test data from the shaker and rocket tests on the containment building of the HDR (Heissdampfreaktor) were used in the effort. The attempted verification was only partially successful in that only one modal model with a limited range of validity could be synthesized from the shaker test data. The goodness of fit in this limited range was adequate. The rocket test data could not be used to synthesize a modal model due to numerical difficulties. However, the effort was useful in showing the need for taking into account the possible use of the data, and the data analysis method to be employed, at an early stage when the tests are being designed.

9930 **(ORNL/TM—9367) Review of the treat upgrade reactor scram system reliability analysis.** Montague, D.F.; Fussell, J.B.; Krois, P.A.; Morelock, T.C.; Knee, H.E.; Manning, J.J.; Haas, P.M.; West, K.W. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 60p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004392.

In order to resolve some key LMFBR safety issues, ANL personnel are modifying the TREAT reactor to handle much larger experiments. As a result of these modifications, the upgraded Treat reactor will not always operate in a self-limited mode. During certain experiments in the upgraded TREAT reactor, it is possible that the fuel could be damaged by overheating if, once the computer systems fail, the reactor scram system (RSS) fails on demand. To help ensure that the upgraded TREAT reactor is shut down when required, ANL personnel have designed a triply redundant RSS for the facility. The RSS is designed to meet three reliability goals: (1) a loss of capability failure probability of 10^{-5}/demand (independent failures only); (2) an inadvertent shutdown probability of 10^{-3}/experiment; and (3) protection agaist any known potential common cause failures. According to ANL's reliability analysis of the RSS, this system substantially meets these goals.

9931 **(PNCT-J—965-82-01) Film boiling heat transfer characteristics of sodium in droplet evaporation on heated tantalum.** Miyazaki, Keiji. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Dec 1982. 34p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE84703450.

For gaining background information on possible vapor explosion in a hypothetical core disruptive accident of liquid metal cooled fast breeder reactors, the experiment on the film boiling characteristics of sodium was conducted in association with Leidenfrost phenomenon. In a steel container filled with 1.0bar argon gas, sodium droplets were put on a heated disk and the behavior of droplets was observed . A tantalum disk of 70mm dia. and 30mm height was induction-heated by an oil-cooled coil and a high frequency power supply of 20kHz and 30kW rating. The wall temperature of the disk was measured by a 1.6mm O.D. Ta-sheathed W-5%Re/W-26%Re thermocouple embedded beneath the disk. The experimental conditions were the initial droplet temperature and volume : 400-500°C and about 1.0cm^3, the initial tantalum disk temperature : 1390-1890°C. The heat flux was estimated from the volumetric reducing rate of droplet due to vaporization, based on photographic observation. The data plots of heat flux, though widely scattering, showed a decreasing trend with the wall superheat in the temperature range of 1390-1600°C, while an increasing trend in the range of 1600-1890°C. The former range suggests to correspond to the transition boiling region and the latter to the film boiling region. Thus, the minimum film boiling point was roughly estimated to be around 1600°C and 45W/cm^2. In the film boiling region the plots came slightly above the theoretical prediction.

9932 **(PNL-SA—12237) Acoustic emission for on-line reactor monitoring: results from field tests.** Hutton, P.H.; Kurtz, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 9p. (CONF-840738—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003110.

From Progress in quantitative NDE; San Diego, CA, USA (8 Jul 1984).

The objective of the acoustic emission (AE)/flaw characterization program is to develop use of the AE method on a continuous basis (during operation and during hydrotest) to detect and analyze flaw growth in reactor pressure vessels and primary piping. AE has the unique capability for continuous monitoring, high sensitivity, and remote flaw location.

9933 **(PNL-SA—12667) Steam generator tube vibration tests.** Enderlin, W.I. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 11p. (CONF-8410142—64). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003599.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The objectives of this research are: (1) to investigate the effects of increased tube/tube-support clearances on rate of tube wear caused by flow-induced vibration in PWR steam generators; and (2) to provide the NRC with criteria to evaluate licensee's specific proposals for chemical cleaning of steam generators.

9934 **(SAND—84-1450C) Uncertainty assessment in probabilistic risk assessment.** Spencer, F.W.; Diegert, K.V.; Easterling, R.G. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 11p. (CONF-850206—11). NTIS, PC A02. File Number DE85003119.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

This paper focuses on our proposal for the different roles that data and expert opinion play in uncertainty analysis. Parameters for which reliable data exist are estimated by classical statistical techniques. Their uncertainty bounds are statistical confidence limits. Uncertainty about data-free parameters is expressed as a range, or set, of plausible values, with no probabilistic connotations. For parameters with both data and opinion sources, conditional confidence limits can be used to assess both total uncertainty, and the separate contributions of data-based and data-free uncertainties.

9935 **(SAND—84-1655C) Performance assessment of Class 1E pressure transmitters subjected to environmental stresses.** Furgal, D.T.; Craft, C.M. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 23p. (CONF-8410142—31). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002623.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Research has been conducted within the Component Assessment Program to evaluate the failure and degradation modes of unaged instruments exposed to environments exposed to environments within and beyond the design basis. Current qualification test requirements as they relate to electronic components in containment were also evaluated. This paper summarizes the salient findings of an experimental evaluation of pressure transmitter performance in harsh environments. The test matrix exposed five ITT Barton Model 763, 0-1000 psig, 4-20mA pressure transmitters to five separate environments: (1) simulated Loss of Coolant Accident (LOCA) steam condition alone, (2) temperature alone, (3) radiation alone, (4) simultaneous radiation and LOCA temperature (no steam) conditions, and (5) simultaneous radiation and simulated LOCA steam conditions. Unaged equipment was tested to establish a baseline performance.

9936 **(SAND—84-1824C) Demonstration uncertainty/sensitivity analysis using the health and economic consequence model CRAC2.** Alpert, D.J.; Iman, R.L.; Johnson, J.D.; Helton, J.C. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1984. Contract AC04-76DP00789. 11p. (CONF-850206—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003338.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

The techniques for performing uncertainty/sensitivity analyses compiled as part of the MELCOR program appear to be well suited for use with a health and economic consequence model. Two replicate samples of size 50 gave essentially identical results, indicating that for this case, a Latin hypercube sample of size 50 seems adequate to represent the distribution of results. Though the intent of this study was a demonstration of uncertainty/sensitivity analysis techniques, a number of insights relevant to health and economic consequence modeling can be gleaned: uncertainties in early deaths are significantly greater than uncertainties in latent cancer deaths; though the magnitude of the source term is the largest source of variation in estimated distributions of early deaths, a number of additional parameters are also important; even with the release fractions for a full SST1, one quarter of the CRAC2 runs gave no early deaths; and comparison of the estimates of mean early deaths for a full SST1 release in this study with those of recent point estimates for similar conditions indicates that the recent estimates may be significant overestimations of early deaths. Estimates of latent cancer deaths, however, are roughly comparable. An analysis of the type described here can provide insights in a number of areas. First, the variability in the results gives an indication of the potential uncertainty associated with the calculations. Second, the sensitivity of the results to assumptions about the input variables can be determined. Research efforts can then be concentrated on reducing the uncertainty in the variables which are the largest contributors to uncertainty in results.

9937 **(SAND—84-1851C) Analysis methods for offsite transport hazards.** Bennett, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 10p. (CONF-850206—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003694.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

The magnitude of the hazardous environment to nuclear plants resulting from offsite accidents involving the transport or storage of hazardous materials and the capacity of the plant to respond to that environment, while remaining within appropriate safety limits, was estimated. The analysis method used for the estimation is summarized. 8 references. (ACR)

9938 **(SAND—84-1887C) Rational quantitative safety goals: a summary.** Unwin, S.D.; Hayns, M.R. (Sandia National Labs., Albuquerque, NM (USA); UKAEA Safety and Reliability Directorate, Culcheth). Aug 1984. Contract AC04-76DP00789. 7p. (CONF-850206—3-Summ.). NTIS, PC A02/MF A01; GPO Dep. File Number DE84017058.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

We introduce the notion of a Rational Quantitative Safety Goal. Such a goal reflects the imprecision and vagueness inherent in any reasonable notion of adequate safety and permits such vagueness to be incorporated into the formal regulatory decision-making process. A quantitative goal of the form, the parameter x, characterizing the safety level of the nuclear plant, shall not exceed the value x_0, for example, is of a non-rational nature in that it invokes a strict binary logic in which the parameter space underlying x is cut sharply into two portions: that containing those values of x that comply with the goal and that containing those that do not. Here, we utilize an alternative form of logic which, in accordance with any intuitively reasonable notion of safety, permits a smooth transition of a safety determining parameter between the adequately safe and inadequately safe domains. Fuzzy set theory provides a suitable mathematical basis for the formulation of rational quantitative safety goals. The decision-making process proposed here is compatible with current risk assessment techniques and produces results in a transparent and useful format. Our methodology is illustrated with reference to the NUS Corporation risk assessment of the Limerick Generating Station.

9939 **(UCID—18958) Technical evaluation of the susceptibility of safety-related systems to flooding caused by the failure of non-category 1 systems for Indian Point, Unit 2.** Latorre, V.R.; Victor, R.A. (Lawrence Livermore National Lab., CA (USA)). Nov 1980. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01. File Number TI85004522.

Purpose of this evaluation was to determine whether the failure of any non-Class I (seismic) equipment could result in a condition, such as flooding, that might adversely affect the performance of the safety-related equipment required for the safe shutdown of the facility, or to mitigate the consequences of an accident. Criteria developed by the US Nuclear Regulatory Commission were used to evaluate the acceptability of the existing protection system as well as measures taken by Consolidated Edison Company of New York (CECNY) to minimize the danger of flooding and to protect safety-related equipment. Based on the information supplied by the licensee, it is concluded that the licensee, CECNY, has demonstrated in its analysis that the Indian Point 2 Power Station has the capacity and capability to manage and mitigate any single incident, such as flooding, from a non-Class I system component or pipe, so that this flooding will not prevent the safe shutdown of the facility.

9940 **(UCRL—91731) Doubled-ended breaks in reactor primary piping.** Holman, G.S. (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 26p. (CONF-8410142—39). NTIS, PC A03/MF A01; GPO Dep. File Number DE85003145.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Results indicate that the probability of double-ended guillotine break (DEGB) in the reactor coolant loop piping of Westinghouse and Combustion Engineering plants is extremely low. It is recommended that the NRC seriously consider eliminating DEGB as a design basis event for reactor coolant loop piping in Westinghouse plants. Pipe whip restraints on reactor coolant loop piping could then be excluded or removed, and the requirement to design supports to withstand asymmetric blowdown loads could be eliminated. It is also recommended that the current requirement to couple safe shutdown earthquake (SSE) and DEGB be eliminated. Recognizing however that seismically induced support failure is the weak link in the DEGB evaluation, it is recommended that the strength of component supports, currently designed for the combination of SSE plus DEGB, not be reduced. The study indicates that the probability of DEGB in reactor coolant loop piping is sufficiently low under all plant conditions, including seismic events, to justify eliminating it entirely as a basis for plant design.

9941 **De-entrainment of liquid on vertical rods in air/water cross flow.** Sundaram, R.K.; Chen, J.C.; Dallman, J.C. (Yankee Atomic Electric Co., Framingham, MA). *Nuclear Science and Engineering;* **88**: No. 3, 287-296(Nov 1984).

Liquid holdup on a 101.6-mm-diam, 0.5588-m-long vertical rod has been measured in air/water cross flow at various air and water flow rates. The measurement technique involved the use of band-type capacitance probes, which are capable of measuring the average liquid film thickness around the rod circumference. The probe is able to provide useful information in the presence of nonuniform films around the rod as well as in rivulet flows. The data are shown to be consistent with previously obtained data on liquid drainage flow rates for a variety of air and water incident flow rates. A simple model, based on laminar flow theory, reasonably explains the trends in film thickness variation.

9942 **Aerosol source term in high pressure melt ejection.** Brockmann, J.E.; Tarbell, W.W. (Sandia National Laboratories, Albuquerque, NM). *Nuclear Science and Engineering;* **88**: No. 3, 342-356(Nov 1984).

Pressurized ejection of melt from a reactor pressure vessel has been identified as an important element of a severe reactor accident. Copious aerosol production is observed when thermitically

generated melts pressurized with nitrogen or carbon dioxide to 1.3 to 17 MPa are ejected into an air atmosphere. Aerosol particle size distributions measured in the tests have modes of about 0.5, 5, and > 10 μm. Mechanisms leading to formation of these multimodal size distributions are suggested. This aerosol is a potentially important fission product source term that has not been considered in previous severe accident analyses.

9943 **Erosion of steel structures by high-temperature melts.** Powers, D.A. (Sandia National Laboratories, Albuquerque, NM). *Nuclear Science and Engineering;* **88**: No. 3, 357-366(Nov 1984).

Molten stainless steel at about 1720°C and melts of iron and alumina or 54 wt% UO_2, 16 wt% ZrO_2, and 30 wt% stainless steel at 2400 to 2800°C were poured onto 0.95- to 7.62-cm-thick steel structures. The melts rapidly penetrated these structures, probably by a thermal ablation process. Coatings of 0.2- to 2-mm-thick urania on the surfaces of the steel delayed penetration by the very high temperature melts. A finite difference model of the experiments is described. The model is used as the basis for predicting the extent of crust formation when melts contact cold steel and to suggest that a gas gap may form between the steel and any crust of frozen material that does form.

9944 **Hydrogen combustion in aqueous foams.** Baer, M.R.; Griffiths, S.K.; Shepherd, J.E. (Sandia National Laboratories, Albuquerque, NM). *Nuclear Science and Engineering;* **88**: No. 3, 436-444(Nov 1984).

Water fogs are recognized as an effective means to mitigate the effects of large-scale hydrogen combustion that might accompany some loss of coolant nuclear reactor accidents. Fogs of sufficiently high density to produce large beneficial effects may, however, be difficult to generate and maintain. An alternate method of suspending the desired mass of water is via high expansion-ratio aqueous foams. Because, in practice, the foam would be generated using the combustible gaseous contents of the containment vessel, combustion occurs inside the foam cells. Although foams generated with inert gas have been well studied for use in fire fighting, little is known about combustion in foams generated with flammable mixtures. To help assess the usefulness of aqueous foams in a mitigation plan, several open-tube tests and more than 100 closed-vessel tests of hydrogen/air combustion, with and without foam were conducted. At low and intermediate hydrogen concentrations, the foam has little effect on the ultimate isochoric pressure rise. Above 15% hydrogen concentration, the foam causes a significant reduction in the pressure rise. The maximum effect occurs at about 28% hydrogen (the stoichiometric limit is 29.6% hydrogen) where the peak overpressure is reduced by 2 1/2. Despite this overall pressure reduction, the flame speed is increased by up to an order of magnitude for combustion in the foam, and strong pressure fluctuations are observed near a hydrogen concentration of 23%.

25 ENERGY STORAGE

2506 Thermal

REFER ALSO TO CITATION(S) 2506009755, 10013, 10014

9945 **(BFR-G—5-1983) Thermochemical energy storage. Basis of the program plan of the Council for Building Research, 1984-1987.** (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 85p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750168.

Thermochemical energy storage and absorption heat pumps are included in a subsection of building research having a grant of about 5 MSEK for the years 1981 to 1984. The report presents the state of the art and recommends some lines of research and development such as application of large adsorption heat pumps and energy storage of short duration. There are no recommendations to accelerate the present efforts.

9946 **(DTH-LV-MEDD—134) Seasonal heat storage in underground warm water stores. Construction and testing of a 500 m^3 store.** Kielsgaard Hansen, K.; Nordgaard Hansen, P.; Ussing, V. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Jul 1983. 85p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85750148.

The aim of the work has been to show that warm water pits, uninsulated towards the soil are well suited for seasonal heat storage. Limiting the insulation to the top surface will contribute to a construction price reduction, which is so important, if seasonal storage shall be economically feasible. A truncated pyramidal geometry completely imbeded in the ground was chosen. The uninsulated store/soil interface was made waterproof by use of a 2.5 mm high density polyethylene liner. The floating insulated lid was constructed in a "dry-dock" and floated to final position. A floating gasket was installed to seal the lid to the pit walls. The inlet and outlet systems for water made circulation of the entire pit volume possible in four days. Two 36 kW gas boilers and an aircooler of about 30 kW made simulated operations between 30degC possible. In order to get an impression of the reduction in heat loss expected by many seasonal operations a sinoidal charge-discharge pattern between 30degC and 60degC over a 70 day-periods was used. The measured temperatures in the soil were compared with the computed temperatures and satisfactory agreement was found based on the actual thermal properties. The storage efficiency measured indicated, that the theoretical expression developed for the seasonal storage efficiency will be in good agreement with the efficiency which will be obtained in practical work.

9947 **(DTH-LV-MEDD—142) Transparent insulation for thermal storage walls.** Olsen, L.; Paludan-Mueller, C. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Jul 1983. 117p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85750135.

Thermal storage walls are an integrated part of the building structure. The central part is a wall model of a material which is able to accumulate heat. The outer side of the wall is used as absorber and a cavity is formed by placing a collector cover on a frame mounted at the wall. This cavity can be filled with transparent insulation. Different types have been investigated: slatted honeycomb, V-corrugated honeycomb, and triangular shaped cylinders covered with a reflective film. The performance has been calculated. The transparent insulation has been constructed and placed in test collectors which are tested in a solar simulator. The test results are compared with the calculations. The V-corrugated honeycomb has been built into a thermal storage wall in a test building. The results are compared with a thermal storage wall without honeycomb. The yearly performance of thermal storage walls used in dwellings has been calculated with a computer simulation model.

9948 **(STUDSVIK—83-2) Salt store as a heating center in small houses.** Lorenz, K.; Zinko, H. (Studsvik Energiteknik AB, Nykoeping (Sweden)). Apr 1983. 39p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750171.

Diplomarbeit 1981.

The report deals with a heating system which uses a latent heat storage consisting of calcium chloride hexahydrate, a stove with warm air circulation and air cooled solar collectors. Technical details and the cost-benefit analysis of the system are discussed. During winter the daily heating time will be 2 to 4 hours. Energy costs are calculated to be 0.30 SEK per kWh. The stove can be replaced by electric heater using low price night time electric power.

2508 Chemical

REFER ALSO TO CITATION(S) 2508009756

2509 Batteries

9949 **(AD-A—144775/4) Sea water rope batteries. Final technical report 15 November 1983-15 May 1984.** Walsh, M. (Simplex Digital Corp., Annandale, VA (USA)). 15 May 1984. 12p. NTIS, PC A02/MF A01.

This research demonstrated the feasibility of supplying approximately 1 watt of electrical power for one year on the sea bed with a novel battery, the rope battery. The proposed battery would look very much like a small diameter wire rope, possibly hundreds of feet long. This unusual shape permits the rope battery to take full advantage of the vastness of the ocean floor and permits at great pressure the steady diffusion of reaction products away from the battery itself. A sea water battery is described consisting of an inner bundle of coated wires which slowly corrode and an outer layer of fine wires which simultaneously provides strength, armor and surface area for slow hydrogen evolution. Two variations are examined. The fuse utilizes magnesium wires and burns slowly from the end. The rope utilizes lithium-zinc alloys and is slowly consumed along its entire length.

9950 **(N—84-29342) Electrochemical storage.** Thaller, L.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 1p. NTIS, PC A12/MF A01.

In Space Photovoltaic Research and Technology, 1983, 235, N—84-29307 19-44.

The source of the problem within the individual single cell which is related to the stochastic properties of cell populations and to the actual electrochemistry and chemistry taking place is described. The complications which arise in multicell batteries to show how different electrochemistries might alleviate or accentuate these problems is described. The concept of the electrochemical system is introduced to show how certain shortcomings of the single cell/battery string concept can be circumvented. Some of these electrochemical systems permit performance characteristics that are impossible by using conventional battery design philosophies. Projections for energy density and performance characteristics of the concepts are addressed.

9951 **(N—84-30528) Development of a lightweight nickel electrode.** Britton, D.L.; Reid, M.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Aug 1984. 20p. (NASA-TM—83739; E—1967). NTIS, PC A02/MF A01.

Nickel electrodes made using lightweight plastic plaque are about half the weight of electrodes made from state of the art sintered nickel plaque. This weight reduction would result in a significant improvement in the energy density of batteries using nickel electrodes (nickel hydrogen, nickel cadmium and nickel zinc). These lightweight electrodes are suitably conductive and yield comparable capacities (as high as 0.25 AH/gm (0.048 AH/sq cm)) after formation. These lightweight electrodes also show excellent discharge performance at high rates.

9952 **(NUREG/CR—3923) Test series 1: seismic-fragility tests of naturally-aged Class 1E Gould NCX-2250 battery cells.** Bonzon, L.L.; Hente, D.B.; Kukreti, B.M.; Schendel, J.S.; Tulk, J.D.; Janis, W.J.; Black, D.A.; Paulsen, G.D.; Aucoin, B.D. (Sandia National Labs., Albuquerque, NM (USA); Ontario Hydro, Toronto (Canada)). Sep 1984. Contract AC04-76DP00789. 233p. (SAND—84-1737). NTIS, PC A11 - GPO. File Number TI85003976.

The seismic-fragility response of naturally-aged, nuclear station, safety-related batteries is of interest for two reasons: (1) to determine actual failure modes and thresholds; and (2) to determine the validity of using the electrical capacity of individual cells as an indicator of the end-of-life of a battery, given a seismic event. This report covers the first test series of an extensive program using 12-year old, lead-calcium, Gould NCX-2250 cells, from the James A. Fitzpatrick Nuclear Power Station operated by the New York Power Authority. Seismic tests with three cell configurations were performed using a triaxial shake table: single-cell tests, rigidly mounted; multi-cell (three) tests, mounted in a typical battery rack; and single-cell tests specifically aimed towards examining propagation of pre-existing case cracks. In general the test philosophy was to monitor the electrical properties including discharge capacity of cells through a graduated series of g-level step increases until either the shake-table limits were reached or until electrical failure of the cells occurred. Of nine electrically active cells, six failed during seismic testing over a range of imposed g-level loads in excess of a 1-g ZPA. Post-test examination revealed a common failure mode, the cracking at the abnormally brittle, positive lead bus-bar/post interface; further examination showed that the failure zone was extremely coarse grained and extensively corroded. Presently accepted accelerated-aging methods for qualifying batteries, per IEEE Std. 535-1979, are based on plate growth, but these naturally-aged 12-year old cells showed no significant plate growth.

29 ENERGY PLANNING AND POLICY

9953 **(DOE/ER/75100—T1) Forecasts of on-site and off-site occupational requirements for energy development in the United States, 1984-1990. Final report.** Schriver, W.R. (Tennessee Univ., Knoxville (USA)). Nov 1984. Contract FG05-83ER75100. 123p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85004092.

This report forecasts labor requirements to construct, operate and maintain new capacity in the nation's energy producing sector. That sector includes coal, gas, oil, and uranium extraction and processing, electrical generation, and energy transportation, including pipelines, transmission and distribution lines and slurries. The estimates of new job openings were made from surveys conducted by Construction Resources Analysis (CRA) and energy supply forecasts made by the Department of Energy. They reflect employment opportunities associated with new energy facilities already under construction, those in advanced planning stages, and forecasted capacity additions during the 1983-1990 period. This report is a continuation of earlier research conducted by CRA for the Department of Energy, using a computerized information system which produces regional forecasts of construction activity and job requirements for residential, nonresidential, non-building and energy construction. The report finds that the nation's new energy production activities will create approximately 59,000 new on-site jobs annually to operate and maintain the new production facilities and will provide about 440,000 jobs each year to construct these facilities. An additional 272,000 new positions in other segments of the economy will be needed annually to support the new energy activities.

2901 Energy Analysis And Modeling

9954 **(EUR—9196/II-EN) Stochastic energy R and D budget allocation model. Vol. 2.** Groote, X. de; Louveaux, F.; Poncelet, A.M.; Smeers, Y. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. 72p. Commission of the European Communities, Ispra (Italy). Biology Div.

In a companion report we studied the use of statistical decision analysis for investigating R-D energy projects. In this paper we examine the feasibility of using stochastic programming methods in the same context. The set of possible R-D decisions and random events relevant to the problem is again structured as a decision tree. For each R-D strategy, the decision tree reduces to a pure event tree where the availability of the different technologies and their cost are known on each branch. The optimal investment strategy on the tree can then be studied by stochastic programming methods in order to arrive at a valuation of the R-D strategy. The report discusses the structuring of the R-D process, the existing stochastic programming methodologies available and the difficulties encountered in their application.

9955 **(TRITA-MAT—1983-10) Optimization of regional energy systems. A computer-based planning model.** Holmberg, G.; Lundqvist, L.; Pettersson, L.; Svanberg, K.; Widlert, S. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Mathematics). 1983. 30p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750181.

The aim of the project was to develop a model which will improve the planning and handling of the following items: cost structures of complete plants, regional network structures and energy flows, energy conversion and conservation on a detailed scale. Simplifications of the original model were necessary. Now the model can be applied to problems concerning various grades of the integration of district heating and the effect on cost. Oil dependence can be investigated and further studies are on the way.

2902 Economics And Sociology

9956 (NUREG/CR—4002) Development and application of econometric demand and supply models for selected Chesapeake Bay seafood products. Nieves, L.A.; Moe, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1984. Contract AC06-76RL01830. 191p. (PNL—5226). NTIS, PC A09/MF A01 - GPO $6.00. File Number TI85003891.

Five models were developed to forecast future Chesapeake seafood product prices, harvest quantities, and resulting income. Annual econometric models are documented for oysters, hard and soft blue crabs, and hard and soft clams. To the degree that data permit, these models represent demand and supply at the retail, wholesale, and harvest levels. The resulting models have broad applications in environmental policy issues and regulatory analyses for the Chesapeake Bay. 37 references, 10 figures, 99 tables.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 2903009504, 9630, 9956, 9966, 9968, 9973, 10383, 10398, 10424

9957 (BNL—35459) Health and environmental risks of energy systems. Hamilton, L.D. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 52p. (CONF-840422—2). NTIS, PC A04/MF A01; GPO Dep. File Number DE85004540.

From International symposium on risks and benefits of energy systems; Juelich, F.R. Germany (9 Apr 1984).

This paper gives four examples of health risk assessments of energy systems: (1) Comparative risk assessment of the health effects of the coal and nuclear fuel cycles. Estimates differ from previous values chiefly by inclusion of ranges of uncertainty, but some coal-cycle numbers were re-estimated. Upper-boundary public disease risks of air pollution from coal-fired plants dominate. Reactors probably account for most of the potential effect of major nuclear accidents. Accidental death rates in electricity generation are low for reactors and higher for coal. (2) Upper boundary air pollution health risks of existing fossil-based energy technologies in the United States. Preliminary mortality estimates were obtained combining potential impacts of three index pollutants - SO_4, NO_3, and CO - as independent measures of risk. Four fuel cycle trajectories leading to three end-uses were analyzed. Example results: domestic wood burning has substantial potential impact, with an upper boundary exceeding that of coal; upper-boundary air pollution impacts of gas can exceed those of oil, because of NO_3. (3) Health risks of acid deposition and other transported air pollutants, carried out as part of an assessment of the US Congress Office of Technology Assessment (OTA) Acid Rain and Transported Air Pollutants - Implications for Public Policy. Three scenarios were examined, leading to estimates of 40,000 to 50,000 annual premature deaths, depending on year (1978 vs 2000) and scenario (holding total emissions constant vs 30% reduction). (4) health effects of uranium mill tailings piles. Mortality risk is estimated to be minuscule (8.7×10^{-9} average individual lifetime cancer risk from a model mill, compared with 9.5×10^{-4} for background radiation). Methods that sum risks over the indefinite future are shown to be to be unrealistic. 39 references, 7 figures, 15 tables.

9958 (CONF-841136—2) Alternative scenarios for generating unit retirement and the impact on SO_2 emissions. Peerenboom, J.P.; Bragen, M.; VanKuiken, J.C.; Hanson, D.A.; Buehring, W.A.; Hub, K.A.; Streets, D.G. (Argonne National Lab., IL (USA)). Nov 1984. Contract W-31-109-ENG-38. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004036.

From 6. annual North American meeting of the International Association of Energy Economists; San Francisco, CA, USA (5 Nov 1984).

This paper describes and illustrates a procedure developed for analyzing the impact on future capacity requirements and SO_2 emissions that results from changes in the planned retirement dates of electric generating units. Because of the complexity of these considerations, the approach described in this paper for analyzing retirement/refurbishment decisions is based on exogenously supplied information about changes in expected unit lifetimes. While detailed unit-specific information can be represented, the developed approach is based on generic representations and lifetimes to allow the broad implications of refurbishment strategies to be examined. 5 figures.

9959 (DOE/ER—0196) Research plan for evaluating the health and ecological effects of complex chemical mixtures. Draft. Stapleton, G.; Wobber, F.J. (USDOE Office of Energy Research, Washington, DC. Office of Health and Environmental Research). Apr 1984. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004493.

A significant part of the OHER research program has been devoted to the health and environmental aspects of exposure to complex chemical mixtures for the last five years. This plan describes the kinds and course of research activities that are needed in that program over the next five years. This plan describes the research needed to complete the evaluation of fossil fuel materials as prototypes for complex materials and the research needed to understand how and why the effects of complex mixtures may be different quantitatively and qualitatively from those observed for individual toxic components of the mixtures. The plan also describes health effects research and the transport of organic chemicals along environmental pathways to humans. It includes those environmental research activities that provide information about the effects of energy-related chemical mixtures on ecosystems. Long-term research related to transport processes and abiotic factors that affect transport is also included because such information is necessary for understanding the extent to which contaminants move along direct and indirect pathways to humans. (ACR)

9960 (GAO/RCED—84-166) Implementation of the Pacific Northwest Electric Power Planning and Conservation Act's fish and wildlife provisions. (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 17 Aug 1984. 48p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI85900447.

Report to The Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives.

Concerned over how hydroelectric facilities on the Columbia River and its tributaries affect the region's fish and wildlife, the Congress moved to protect these natural resources through provisions of the Northwest Power Act. The act directed the Pacific Northwest Electric Power and Conservation Planning Council to prepare and adopt a regional fish and wildlife program. Congressman John Dingell asked GAO to review actions taken by the Council, the Bonneville Power Administration, and others to implement the fish and wildlife program. This report responds to the Congressman's six questions pertaining to funding and staffing levels, costs, and program focus or emphasis.

2904 Natural Resources

REFER ALSO TO CITATION(S) 2904009958

9961 (BFR-R—61-1983) Land for energy forest. Basis of municipal energy planning with examples from Tierp and Aelvkarleby. Aakerblom, K. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 96p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750159.

The underlying principles of surveying the ground for energy forest and different methods to accomplish the task are described. The inventory is applied to municipal level and it is presented in the form of maps and descriptions over Tierp and Aelvkarleby. It is stated that the reliability of the statistical methods is inferior to the interpretation of air photos, the latter delivering 88% confidence.

9962 **(BFR-R—95-1983) Natural heat sources at Sollentuna (Sweden). Investigation of methods and available potentials.** Andersson, S.; Eriksson, A.; Krook, O.; Aabyhammar, T. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 80p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750158.

The technical and economically exploitable energy potential of the solar heated ground and water systems of the municipality of Sollentuna has been surveyed. The following conditions are considered: the extraction of energy should be made by established technique; seasonal heat storage is not observed; the obtained temperature level ca 70 degrees C is sufficient. The cost of the various individual energy sources has been calculated to be 0.17 to 0.40 SEK per kWh for heat from ground and sea water, whereas waste water heat is calculated to 0.15 SEK per kWh. The total cooling energy potential, 143 GWh and the necessary electric power 87 GWh are calculated to make out ca 40% of the heating demand by 1990.

9963 **(DOE/FE/60406—T1-Vol.1) Selective permit requirements for natural resource development, land use regulation, environmental quality management, social/ecological preservation, and local regulatory policy. Volume 1. Colorado, Wyoming, Montana, and North Dakota.** Cox, E.; Veselick, E. (eds.). (Fuel and Mineral Resources, Inc., Reston, VA (USA)). Sep 1983. Contract AC02-83FE60406. 277p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85005079.

This regulatory guide lists permit requirements for Colorado, Wyoming, Montana, and North Dakota. (ACR)

9964 **(DOE/FE/60406—T1-Vol.2) Selective permit requirements for natural resource development, land use regulation, environmental quality management, social/ecological preservation, and local regulatory policy. Volume 2. South Dakota, Utah, New Mexico and California.** Cox, E.; Veselick, E. (eds.). (Fuel and Mineral Resources, Inc., Reston, VA (USA)). Sep 1983. Contract AC02-83FE60406. 297p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85005080.

This regulatory guide lists permit requirements for South Dakota, Utah, New Mexico, and California. (ACR)

9965 **(DOE/FE/60406—T1-Vol.3) Selective permit requirements for natural resource development, land use regulation, environmental quality management, social/ecological preservation, and local regulatory policy. Volume 3. Arizona, Oregon, Washington, Alaska, Florida, and Maryland.** Cox, E.; Veselick, E. (eds.). (Fuel and Mineral Resources, Inc., Reston, VA (USA)). Nov 1983. Contract AC02-83FE60406. 294p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85005081.

This regulatory guide lists permit requirements for Arizona, Oregon, Washington, Alaska, Florida, and Maryland. (ACR)

9966 **(DOE/FE/60406—T1-Vol.5) Selective permit requirements for natural resource development, land use regulation, environmental quality management, social/ecological preservation, and local regulatory policy. Volume 5. Trends in consolidated permitting procedures and land use regulatory policy.** Cox, E.; Veselick, E. (eds.). (Fuel and Mineral Resources, Inc., Reston, VA (USA)). Dec 1983. Contract AC02-83FE60406. 303p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85005083.

This report presents brief outlines of the clearinghouse, one-stop, major facility siting, and local land use regulations of western energy states and a few eastern states with comprehensive land use laws. Some selective state approaches to environmental, health, safety, and socioeconomic impact mitigation are analyzed. Western state practices in regulating the siting of industrial facilities are discussed. (ACR)

9967 **(LiU-TemaV-RB—83-5) Integrated land and water use planning. Data bases and analysis methods.** Castensson, R.; Karlsson, S.; Loenegren, H.; Ryding, S.O.; Sanden, P.; Zachrisson, G. (Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society). 1983. 154p. (In Swedish). University of Linkoeping, Department of Water in Environment and Society, S-581 83 Linkoeping, Sweden. File Number TI85750192.

Many water quality deteriorations are caused by imprudent land-use. Examples are leakage from arable land, mining tails, urban areas, and waste deposits. The aim of the project is to develop methods for an integrated approach on land-use and water-use problems. In the report different types of data bases are demonstrated: water quantity and water quality, actual municipal water-use, water-use conflicts, land-use with water quality implications, water quality trends, conflict areas, etc. The application area is Aatvidaberg municipality.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 2905009959

9968 **(N—84-26476) Department of Housing and Urban Development-Independent Agencies Appropriations Bill, 1985.** (Committee on Appropriations (U.S. Senate), Washington, DC). 1984. 116p. (GPO—35-356). US Capitol, Senate Document Room, Washington, DC.

Federal aappropriations for the Department of Housing and Urban Development and for sundry independent agencies, boards, commissions, corporations, and offices are enumerated and discussed. Recommendations by the House Committee on Appropriations are given along with a detailed description of each program considered. Specific programs discussed include: urban research, urban development, urban planning, solar energy, environmental quality, space stations, space shuttle orbiters, scientific research and education, and selective service. This bill, H.R. 5713, makes appropriations for the fiscal year ending September 30, 1985.

9969 **(ORAU—238) Technology Transfer Program. Annual report, FY 1984.** (Oak Ridge Associated Universities, Inc., TN (USA)). Oct 1984. Contract AC05-76OR00033. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004491.

In FY 1984, ORAU provided services to DOE and other federal agencies, government-owned contractor-operated organizations, private industry, and state and local governments. As a member of the Federal Laboratory Consortium for Technology Transfer, ORAU encourages the transfer of technology between federal facilities and ORAU member universities. Through its involvement in Tennessee Technology Corridor activities, association with the Tennessee Innovation Center planners, and development of its own research park, ORAU supports regional economic growth.

9970 **DOE's fiscal year 1985 budget. Hearings before the Subcommittee on Energy Conservation and Power and the Subcommittee on Fossil and Synthetic Fuels of the Committee on Energy and Commerce, House of Representatives, Ninety-Eighth Congress, Second Session, February 9, 22, and 28, 1984.** Washington, DC, USA; Government Printing Office (1984). 838p.

Three days of hearings to review the 1985 DOE budget reflected the shift in priorities from the support of solar energy and conservation to that of nuclear weapons. At issue, besides the changing emphasis, was the high level of support for fusion research at a time when budget deficits are a major concern. Other issues were nuclear waste management and DOE procedures and performance. The 21 witnesses included Donald Hodel and other DOE personnel, representatives of utilities and environmental groups, and other government agency officials. Material submitted for the record follows the testimony.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 2906009828, 9963, 9965

2907 Transport And Storage

REFER ALSO TO CITATION(S) 2907009539

2910 Conservation

REFER ALSO TO CITATION(S) 2910009970, 10038, 10041

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 2920009552, 9574, 9975

9971 **(Ds-I—1983:4) Government support to oil substitution. Evaluation of the activity of the oil substitution fund and proposals for continued operations.** (Industridepartementet, Stockholm (Sweden)). 1983. 155p. (In Swedish). NTIS (US Sales Only), MF A01. File Number DE85750162.

The commission presents an evaluation of the supporting actions to substituting oil. The investigation includes a survey of oil substitution in new type of plants for energy conversion and a calculation of possible oil substitution by establishing novel fuel productions. The special support to prototypes and demonstration plants is also evaluated. The subsidies have been administred by the Oil Substitution fund. The rules for the distribution of the funds are discussed.

9972 **(OTA-E—244) US vulnerability to an oil import curtailment: the oil replacement capability. Summary.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Sep 1984. 43p. Congressional and Public Affairs Office, OTA-US Congress, Washington, DC 20510. File Number TI85900703.

This report responds to a request by the Senate Committee on Foreign Relations for an analysis of the US oil replacement capability in the event of an oil supply shortfall of indefinite duration. The assessment complements several other OTA reports related to energy efficiency and oil replacement. The report analyzes energy supply and demand technologies which can replace large amounts of oil within 5 years after the onset of a major oil supply shortfall, occurring within the next few years and accompanied by a large and enduring increase in oil prices. Emphasis is placed on those technologies that are commercially available now or are likely to be commercial by 1985, and, within this group, attention is given to the least cost alternatives to oil. In addition, the report analyzes the macroeconomic effects of an oil shortfall and how these effects could be influenced by different rates of investment in the oil replacement technologies. 49 figures, 40 tables.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 2930009607, 9963, 9964, 9965, 9966, 9970

9973 **Implementation of the Acid Precipitation Act of 1980. Hearing before the Committee on Energy and Natural Resources, United States Senate, Ninety-Eighth Congress, Second Session, April 30, 1984.** Washington, DC, USA; Government Printing Office (1984). 1806p.

The Acid Precipitation Act of 1980 recognized the potential danger of acid deposition by establishing a 10-year research program. Hearings to assess the progress in implementing the Act reviewed the administration's argument for further research as opposed to those who feel immediate steps are in order. Relevant issues were the impact of the stringent air pollution control on the economy and employment. The 26 witnesses included Energy Secretary Hodel, Environmental Protection Agency Director Ruckelshaus, and representatives of environmental groups, electric utilities, the coal industry, and universities. Eight appendices with additional material submitted for the record follow their testimony.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 2940009515, 9552, 9574, 9578, 9963, 9963, 9963, 9964, 9964, 9964, 9965, 9966, 9966, 9966, 9972

9974 **(DOE/ER/10084—T1) Extending oil and gas supply modeling to immature basins and provinces.** (Mortada International, Dallas, TX (USA)). Jun 1980. Contract AC05-79ER10084. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003979.

The Arps/Mortada/Smith (AMS) Model has been used to predict the future supply and ultimate recoverable reserves of oil and gas as a function of future exploratory effort. The AMS Model applies to a basin or a province and it incorporates four fundamental parameters. The value of each parameter is estimated empirically by a history-matching procedure in which the standard deviation between the actual historic data (reserves and exploratory effort) and model performance is computed. The values of model parameters which minimize the standard deviation are considered the most probable values. The parameters thus determined are used to forecast future supply. Because of the history-matching procedure, the AMS Model is applicable only to mature basins and provinces which have had a significant amount of exploratory activity. However, a need exists to deveop methodology for immature basins, because relatively virgin basins in the frontier areas are going to play a progressively important role in the future supply of oil and gas in the US. The modified AMS Model presented here circumvents the need for extended historic data and thus makes the model applicable to immature basins and provinces. The modified model will be referred to as the Extended AMS Model. The Extended AMS Model incorporates new formulations which utilize: estimates of the basin's attributes which are based on analogy with other basins which were formed under similar geologic conditions; the relationship between basin attributes and field size distribution; the effects of the exloratory strategy; and results of early exploratory effort. The concepts are expressed mathematically. They augment the AMS Model and contribute to early definition of basin parameters. 11 references, 6 figures.

9975 **(OTA-E—243) US vulnerability to an oil import curtailment: the oil replacement capability.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Sep 1984. 157p. GPO*. File Number TI85900702.

This is the summary of a report that responds to a request by the Senate Committee on Foreign Relations for an analysis of the US oil replacement capability in the event of an oil supply shortfall of indefinite duration. The report analyzes energy supply and demand technologies which can replace large amounts of oil within 5 years after the onset of a major oil supply shortfall, occurring within the next few years and accompanied by a large and enduring increase in oil prices. Emphasis is placed on those technologies that are commercially available now or are likely to be commercial by 1985, and, within this group, attention is given to the least cost alternatives to oil. In addition, the report analyzes the macroeconomic effects of an oil shortfall and how these effects could be influenced by different rates of investment in the oil replacement technologies. 5 figures, 2 tables.

9976 **(PB—84-235258) Alternative solutions to railroad impacts on communities. Phase 1. Problem identification.** (Ernst and Whinney, Washington, DC (USA)). Oct 1981. 29p. NTIS, PC A03/MF A01.

See also PB84-235274. Sponsored in part by North Dakota State Highway Dept., Bismarck and Minnesota Dept. of Transportation, St. Paul. Prepared in cooperation with Barton-Aschman Associates, Inc., Minneapolis, MN.

This report presents a summary of the first phase of a study to identify community problems resulting from railroad operations and community activity conflicts. It also attempts to develop low-cost ways to resolve these problems. This project was initiated as a result of the increasing significance of the coal train impact issue nationally. This phase identified the railroad operation/community problems (existing and perceived) in the corridor; determined which communities had the most severe problems and choose those for more in-depth study.

9977 **(PB—84-235266) Alternative solutions to railroad impacts on communities. Phase 2. Case studies.** (Ernst and Whinney, Washington, DC (USA)). Oct 1981. 40p. NTIS, PC A03/MF A01.

See also PB84-235258. Sponsored in part by North Dakota State Highway Dept., Bismarck and Minnesota Dept. of Transportation, St. Paul. Prepared in cooperation with Barton-Aschman Associates, Inc., Minneapolis, MN.

This report identifies and studies the problems of communities as a result of railroad operations. The entire study is in three volumes of Problem Identification, Case Studies, and a Summary Report. This volume illustrates six case studies of communities experiencing conflicts. In each case, alternative, low-cost actions were identified and remedial actions demonstrated. The communities selected were typical of those being affected by the operations of unit coal trains as they have grown in significance in meeting the nation's energy requirements.

9978 **(PB—84-235274) Alternative solutions to railroad impacts on communities. Summary report.** (Ernst and Whinney, Washington, DC (USA)). Oct 1981. 50p. NTIS, PC A03/MF A01.

See also PB84-235266. Sponsored in part by North Dakota State Highway Dept., Bismarck and Minnesota Dept. of Transportation, St. Paul. Prepared in cooperation with Barton-Aschman Associates, Inc., Minneapolis, MN.

This final summary report is third volume in a study which identified community problems arising from conflicts between railroad operations (particularly unit coal trains) and community activities. This report reviews the problems identified, highlights the outcomes of the demonstration projects and provides the low-cost solutions and recommendations to solve the problems.

2980 Consumption And Utilization

9979 **(DOE/EIA—0035(84/08)) Monthly Energy Review, August 1984.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Nov 1984. 117p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. File Number DE85004280.

The Monthly Energy Review presents current data on production, consumption, stocks, imports, exports, and prices of the principal energy commodities in the United States. Also included are data on international production of crude oil, consumption of petroleum products, petroleum stocks, and production of electricity from nuclear-powered facilities. The United States produced 9.5% more energy during the first 8 months of 1984 than during the same period in 1983, and US energy consumption was up 6.6%. Net imports of all energy were 13.4% higher, with net imports of petroleum up 15.0% compared to those imports in the first 8 months of 1983. Energy production during August 1984 totaled 5.8 quadrillion Btu, a 9.8% increase compared to the level of production during August 1983. Coal production increased 22.3%, natural gas production was up 7.3%, and petroleum production increased 1.7%. Production of all other forms of energy combined increased 4.8% compared to production 1 year earlier. Energy consumption during August 1984 totaled 6.1 quadrillion Btu, 2.8% above the level of consumption during August 1983. Petroleum consumption increased 4.2%, natural gas consumption was up 2.4, and coal consumption increased 0.1%. Consumption of all other forms of energy combined increased 4.8% compared to consumption during August 1983. Net imports of energy during August 1984 totaled 0.6 quadrillion Btu, 24.4% below the level of net imports during August 1983. Net imports of petroleum decreased 21.8% while net imports of natural gas increased 4.0%. Net exports of coal were down 1.6% compared to the level in August 1983.

9980 **(DOE/EIA—0035(84/09)) Monthly Energy Review, September 1984.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 24 Dec 1984. 125p. NTIS, PC A06/MF A01 - GPO; GPO Dep. File Number DE85005102.

This report presents current data on production, consumption, stocks, imports, exports, and prices of the principal energy commodities in the United States. Also included are data on international production of crude oil, consumption of petroleum products, petroleum stocks, and production of electricity from nuclear-powered facilities. Energy production during September 1984 totaled 5.4 quadrillion Btu, a 6.3% increase compared to the level of production during September 1983. Coal production increased 12.9%, natural gas production was up 6.5%, and petroleum production increased 0.2%. Production of all other forms of energy combined increased 6.7% compared to production 1 year earlier. Energy consumption during September 1984 totaled 5.6 quadrillion Btu, 1.1% above the level of consumption during September 1983. Natural gas consumption increased 4.4%, coal consumption was up 0.2, while petroleum consumption decreased 1.2%. Consumption of all other forms of energy combined increased 6.9% compared to consumption during September 1983. Net imports of energy during September 1984 totaled 0.6 quadrillion Btu, 23.8% below the level of net imports during September 1983. Net imports of petroleum decreased 17.3% and net imports of natural gas decreased 15.9%. Net exports of coal were up 16.0% compared to the level in September 1983. Numerous figures and tables.

9981 **(EPRI-EA—3698-CCM-Vol.2) Hourly Electric Load Model (HELM). Volume 2. User's guide.** Linder, K.P.; Inglis, M.R.; Dickson, C.T. (ICF, Inc., Washington, DC (USA)). Oct 1984. 195p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920115.

The Hourly Electric Load Model (HELM) was developed by ICF Incorporated for the Electric Power Research Institute under EPRI Project RP-1955-1. The model forecasts hourly electrical loads over the long term. This is the first of two related volumes which document Version 1.0 of HELM. These two volumes are entitled: Volume II: User's Guide; and Volume III: Programmer's Manual. Volume I summarizes the development and testing of HELM. The discussion of model implementation in this volume is intended to be complete. However, quetions may arise. If they do, the reader should refer to Volume III which lists and describes the HELM FORTRAN computer code. The first section of this guide summarizes the overall model design. It describes the major algorithms and flow of computations within the model. The major capabilities of the model are also discussed. Section 2 presents a brief introduction to running the model. This section summarizes the major input files required to run the model, and illustrates the steps involved in running various types of forecasts. Section 3 documents each of the model input files in detail. Section 4 documents the output reports reproduced by the model.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 2990009965

9982 **(PB—84-236256) Candidate technologies to relieve the European energy system: France. Final report.** Kracht, G. (Commission of the European Communities, Luxembourg). 1983. 60p. (EUR—8635-EN-230). NTIS, PC E04/MF E04.

The RANGE programme makes it possible to rank the various candidate technologies, i.e. those technologies that comprise a R and D phase and other new technologies that have already reached the commercialization phase. This programme highlights the variation in the objective function when the capacity varies by approximately one unit, according to whether or not the technology penetrates the market. The Annexe gives the detailed ranking of the various technologies for the four cases taken into consideration. In the nuclear moratorium case the most important changes are a better ranking of fluidized bed boilers in district heating and centralized electricity production. Most solar technologies and the wind turbines have the lowest rank.

9983 **(SLU-IVL—148) Fuel chips change during one year of storage.** Thoernqvist, T. (Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Virkeslaera). 1983. 77p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750185.

The purpose of this study is to illuminate how moisture content, dry matter loss, ash content, heat value and total fungal particles change during one year's storage of chipped logging residues (slash), piled. When the piles were built, six measurement points were laid out in each of 6 cross-sectional cuts at 3 meter intervals.

Every other month during a 12-month period the study was controlled by opening the pile by moving 3 meters of the pile to the side. When the piles were built the average moisture content varied in the different sections between 32 and 39%. During the storage period the 'cuts' average moisture content increased, and varied at the times of control between 36 and 50%. The sections average matter loss value per month was greatest after four month storage. The study has shown that matter losses are entirely dependent on the materials moisture content at the time the pile is laid. The measured energy loss during storage varies between 11.5% and 23.7%. The largest cause for the loss is the matter loss and pollutants. The total number of viable fungal particles increased during the first two storage months on an average for the section by 1000 times. After 4 months the increase was 8000 times. The last 4 months the total of the viable fungal particles decreased somewhat.

9984 **The Establishment and Operation of a Solar Energy Meteorological Research and Training Site.** Healey, J.; Stewart, R. (Scott-Healey Associates, Executive Park Tower, Albany, New York). pp 2653-2658 of Solar World Congress. Vol. 4. Szokolay, S.V. Oxford, England; Pergamon Press (1983). (CONF-830839—).

From Solar world congress; Perth, Australia (15 Aug 1983).

In 1977 the U.S. Department of Energy provided funding for the implementation of eight Solar Energy Meteorological Research and Training Sites (SEMRTS) in the USA. Objectives of these sites were (1) the development of a high quality data collection station, (2) the establishment of a university level program in solar meteorology, and (3) the development of a solar research program. The State University of New York at Albany's Atmospheric ScienceS Research Center (ASRC) was selected as the Region II SEMRTS. This paper documents the initial phases of, the ongoing operation of, and the results from the SEMRTS program.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

9985 **(AD—269213/5) Study of electrical energy conversion systems.** Sherman, A.; Sutton, G.W. (General Electric Co., Philadelphia, PA (USA). Missile and Space Div.). Sep 1961. 10p. NTIS MF A01.

A number of theoretical and experimental investigations were carried out to investigate Magnetohydrodynamic (MHD) and Electrohydrodynamic (EHD) power generation. The theoretical studies included analysis of both optimum channel configuration, and optimum initial conditions for an MHD generator, as well as an analysis of the performance of an idealized EHD generator. The experimental studies centered largely on nonequilibrium ionizatio experiments using a plasma jet as a source of high temperature gas. Finally, some calculations were carried out for the constant velocity MHD generator performance, and the investigation of an oxy-cyanogen MHD generator was begun.

9986 **(AD—269409/9) Theoretical performance analysis of a constant velocity MHD generator for combustion products of hydrocarbon and air.** Blecher, S. (General Electric Co., Philadelphia, PA (USA). Missile and Space Div.). Oct 1961. 10p. NTIS MF A01.

Calculations are performed along a constant velocity, dc, MHD generator utilizing stoichiometric products of hydrocarbon and air. The gas is assumed to be in thermal equilibrium and representable by a Boltzman distribution so that the degree of ionization can be determined by means of the Saha equation. Variations in pressure, temperature, gaseous electrical conductivity, density, entropy, enthalpy, number density, degree of ionization and electron motion are shown graphically as a function of channel length.

9987 **(AD—270479/9) Vortex magnetohydrodynamic generator design study.** Knoernschild, E.M.; Starck, H.G. (Garrett Corp., Los Angeles, CA (USA). Airesearch Mfg. Div.). Nov 1961. 10p. NTIS MF A01.

Processes in the generation of electric power in a vortex MHD generator were studied. Emphasis was on the analysis of vortex flow characteristics and development of design equations for computer methods of solution. Other areas included plasma generation, heat transfer, and materials for vortex MHD generator application. For the investigation of plasma generation, a limited test activity was conducted to determine the voltage breakdown characteristics of alkali metal vapors. MHD flow characteristics of a vortex channel can be obtained analytically; solutions to the various design and performance equations can best be obtained by computer methods. The relations for obtaining the composition of seeded combustion gases were also derived for computer solutions. Heat transfer analysis revealed that insulation of the vortex is a serious problem due to the increased separation of the magnetic poles, and that the minimum insulation is obtained with the maximum external wall temperatures and an appropriate control of the cooling rates.

9988 **(AD—275059/4) Energy conversion in laminar magnetohydrodynamic channel flow.** Penhune, J.P. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). Aug 1961. 10p. (TR—61294). NTIS MF A01.

The aim of this investigation was to develop a clear and detailed understanding of laminar conduction and induction-driven magnetohydrodynamic channel flows, and of the ways in which they can operate as energy converters. The development proceeds from the fundamental equations of incompressible magnetohydrodynamics to the fundamental solutions for the fluid velocity and the magnetic field, and thence to the basic energy conversion properties of the flow.

9989 **(AD-A—144147/6) Preliminary design of a reuseable PPMHD (pulsed plasma MHD) power supply test bed facility. Final report 19 September 1983-31 May 1984.** Gill, S.P.; Shimmin, W.L.; Watson, J.D. (Artec Associates, Inc., Hayward, CA (USA)). May 1984. 66p. (FR—188). NTIS, PC A04/MF A01.

This report describes a preliminary design of a reuseable pulsed plasma Magnetohydrodynamic, (PPMHD) power supply test bed facility that operates in the gigawatt/megajoule regime. The current status of PPMHD component technologies is described as a basis for present and future hardware designs. This includes a discussion of an approach to self-excited operation which is an extension of demonstrated component technologies. Size scaling relations are presented for estimating PPMHD power supply weights in terms of electrical output power and energy.

3002 Ehd Generators

REFER ALSO TO CITATION(S) 3002009985

3005 Fuel Cells

9990 **(ANL—84-65) Advanced fuel cell development. Progress report, April-June 1984.** Pierce, R.D.; Claar, T.D.; Dees, D.W.; Fousek, R.J.; Kaun, T.D.; Kucera, G.H.; Minh, N.Q.; Mrazek, F.C.; Poeppel, R.B.; Smith, J.L. (Argonne National Lab., IL (USA)). Nov 1984. Contract W-31-109-ENG-38. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004830.

This report describes fuel cell research and development activities at Argonne National Laboratory (ANL) during the period April through June 1984. These efforts have been directed toward seeking alternative cathode materials to NiO for molten carbonate fuel cells. Particular emphasis has been placed on studying the relationship between synthesis conditions and the resistivity of doped and undoped $LiFeO_2$ and Li_2MnO_3 and on achieving a better understanding of the crystalline defect structures of the thermodynamically stable phases. To this end, several experimental assemblies (including synthesis, solubility, and sintering vessels and a high-pressure thermogravimetric analyzer) have been constructed to permit 10-atm operation. In addition, data on solubility and cathode cation-$LiAlO_2$ interaction were taken for NiO, Li_2MnO_3, Mg-doped Li_2MnO_3, $LiFeO_2$, and ZnO at 1- and 10-atm pressure, and ion migration from $LiFeO_2$ and Li_2MnO_3 in the cell environment for 200 and 1000 h was examined. Techniques are being studied for the preparation of thin electrode and electrolyte materials by tape cast-

ing. A study to provide improved understanding of anode creep and densification occurring under fuel cell conditions is under way.

9991 **(N—84-21348) Research and development on high temperature water vapor electrolysis.** Schouler, E.J.L.; Viguie, J.C. (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, 38 - Grenoble (France)). Oct 1983. 10p. NTIS, PC A16/MF A01.

In Brookhaven National Lab., proceedings of the conference on high temperature solid oxide electrolytes, Volume 1, 57-66, N—84-21342 11-76.

The feasibility of elementary planar cells for high temperature water electrolysis based on yttria stabilized zirconia electrolytes is discussed. These cells are characterized by a large active surface area (approximately 50 sq cm) and a small electrolyte thickness (approximately 300 microns). Technological difficulties encountered in the fabrication procedure are presented. Parallel research on cathodic reaction kinetics emphasizes an electrocatalytic effect which is conducive to a large decrease of the cathodic overvoltage. This favorable effect, obtained by superficially doping the electrolyte surface with a specific redox couple is even larger the greater the hydrogen concentration. The results obtained give evidence of: an increase of about 10 to 50 in the electrolysis current for a ceria doped surface with nickel electrodes, and a large decrease of the cathodic overvoltage (up to 90%) at a given current when the molar fraction of H2 tends to unity. These results show a way to overcome the theoretical limitation associated with the tubular structure and may justify renewed interest in such a structure based on doped cells.

9992 **(N—84-21350) Fusion and high temperature electrolysis.** Fillo, J.A.; Powell, J.R.; Benenati, R.; Malick, F. (Brookhaven National Lab., Upton, NY (USA)). Oct 1983. 8p. NTIS, PC A16/MF A01.

In Brookhaven National Lab., proceedings of the conference on high temperature solid oxide electrolytes, Volume 1, 81-88, N—84-21342 11-76.

A number of technical approaches for using the thermal energy produced in a high-temperature Tokamak blanket to provide the electrical and thermal energy required to drive a high-temperature (1000 C) water electrolysis process were investigated. Current emphasis is on two design points, one consistent with a peak electrolyzer temperature of approximately 1150 C (based on current laboratory experience with high-temperature, solid electrolyte fuel cells), and a second, consistent with a peak electrolyzer temperature of approximately 1300 C, which is an extrapolation of present experience. The technical integration of fusion and high-temperature electrolysis appears feasible.

9993 **(N—84-21351) High temperature oxide electrolytes for the splitting of water. The ROC process.** Fletcher, E.A.; Diver, R.B.; Noring, J.E. (Minnesota Univ., Minneapolis (USA)). Oct 1983. 14p. NTIS, PC A16/MF A01.

In Brookhaven National Lab., proceedings of the conference on high temperature solid oxide electrolytes, Volume 1, 89-102, N—84-21342 11-76.

Solid oxygen passing membranes such as stabilized zirconia were proposed for use as membranes in high temperature water splitting processes. Two-membrane systems, reduced oxygen concentration (ROC), which use a hydrogen passing membrane as well are discussed. An advantage of a two-membrane system is that water may be split in a single passage through the device, thus decreasing substantially thermodynamic losses associated with the heat exchanger and other appurtenances. Some problems such as the stability of hydrogen passing membranes in a water atmosphere are addressed. It is suggested that the ROC process may provide a means of protecting hydrogen passing membranes, and that electric ROCs may be unusually well suited for operation at temperatures at which palladium membranes might be used. The thermal efficiencies of two membrane systems with and without electrical enhancement are compared.

9994 **(N—84-21363) Some non-electrochemical requirements for air electrode materials of high temperature solid electrolyte fuel cells.** Ruka, R. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Oct 1983. 8p. NTIS, PC A16/MF A01.

In Brookhaven National Lab., proceedings of the conference on high temperature solid oxide electrolytes, Volume 1, 295-302, N—84-21342 11-76.

Non-electrochemical properties of air electrode materials, including thermal expansion, sintering behavior, dimensional changes due to changing oxygen partial pressure and chemical interactions with other cell components, affect the mechanical and chemical integrity of high temperature solid electrolyte fuel cells. Experimental examples of some of the properties which result in undesired dimensional changes are discussed.

9995 **(N—84-21366) Mechanisms of catalytic oxidation of hydrocarbons in a solid-electrolyte fuel cell.** Nguyen, B.C.; Mason, D.M. (Stanford Univ., CA (USA)). Oct 1983. 17p. NTIS, PC A16/MF A01.

In Brookhaven National Lab., proceedings of the conference on high temperature solid oxide electrolytes, Volume 1, 331-347, N—84-21342 11-76.

Results presented in this paper are part of an ongoing investigation of the electrocatalytic mechanisms involved in the anodic oxidation of hydrocarbons and the cathodic reduction of O2 in a fuel cell employing Sc2O3- or Y2O3-stabilized ZrO2. The general status of the electrochemical studies is reviewed. The particular focus of this paper is on experiments performed to test the assumption that the solid electrolyte plays an important role in electrocatalysis compared to the porous metallic electrode. It has been observed that great enhancement in reaction-rates and current drawn at a given overpotential occurs when the electrolyte is blackened by electrolysis, forming a suboxide of zirconia, ZrO2-x. Simple potentiometric measurements with H2 as the fuel and air as oxidant have been made on both the unblackened and blackened ZrO2-Sc2O3 system.

9996 **(N—84-21367) Oxygen exchange measurements on zirconia-yttria electrolyte surfaces modified by various dopants.** Tannhauser, D.S.; Kilner, J.A.; Steele, B.C.H. (Imperial Coll. of Science and Technology, London (UK)). Oct 1983. 12p. NTIS, PC A16/MF A01.

In Brookhaven National Lab., proceedings of the conference on high temperature solid oxide electrolytes, Volume 1, 349-360, N—84-21342 11-76.

Yttria stabilized zirconia (YSZ) has a number of practical applications as electrolyte membrane. Current interest is focused on three main devices: oxygen monitors, high temperature fuel cells, and water electrolyzers. Little is known about factors which affect the interchange of oxygen between the ambient gas and the oxide surface. Surface perfection and purity, as well as crystalline orientation, may all play a role. In view of the growing requirement for devices to operate at low temperatures (approx. 500 C), where the surface exchange becomes very slow, it is important to understand this process. Recent experiments have suggested that surface treatment of zirconia with CeO2 may accelerate reaction kinetics at electrodes. Another series of experiments by Verkerk et al has suggested that in the low temperature regime Bi2O3 - Er2O3 has much faster transfer rate for oxygen than YSZ. Consequently, a series of experiments have been started to investigate the effects of chemical treatments on the exchange of oxygen between the surface of YSZ single crystals and oxygen in the gas phase.

9997 **(TN—1696) Fuel cell power systems for Navy applications.** Major, W.R.; Miles, C.R. (Naval Civil Engineering Lab., Port Hueneme, CA (USA)). May 1984. 105p. Commanding Officer, Code L14, Naval Civil Engineering Lab., Port Hueneme, CA 93043. File Number TI85900423.

A fuel cell power plant can supply both thermal and electrical energy to a site load. The technical and economic attractiveness of using a fuel cell system for a given application depends on many factors such as: satisfying load requirements, reliability, local energy costs, and capital costs. Satisfying site load requirements cost effectively requires a properly sized fuel cell system operating in its optimum mode. A computer program was developed to simulate the dynamic input/outputs of the fuel cell system (fuel cell, auxiliary boiler, thermal storage, electrical grid) and evaluate the separate system operational costs. Using the computer simulation in an iterative method, the optimum operational mode and size of the fuel cell and thermal storage can be estimated. A life-cycle-cost

analysis for a given application can be performed using current manufacturer hardware costs and energy input/output data generated from the computer simulation.

3008 Miscellaneous Converters

9998 (AD—288073/0) Thermokinetic ion converter study. Parthasarathy, R.; Vodopia, A.L. (Garrett Corp., Los Angeles, CA (USA). Airesearch Mfg. Div.). Jun 1962. 10p. (SS—689-R). NTIS MF A01.

The possibility of extracting electric power from an ionized gas stream is investigated. A literature search on Thermokinetic converters and thermal ionization with effects of non equilibrium conditions taken into account was made. Investigations regarding space charge neutralization and an analysis of power generation without explicit charge separation are included. Analytical studies regarding one dimensional flow of an ionized gas and the interaction of ions and neutrals are detailed. For the experimental phase of this study a converter consistent with the analytical conclusions was designed and tested under optimum conditions to investigate the principle of energy conversion and its feasibility as a power generating device. The design of the converter and the testing procedure are described. The results of the experimental study are discussed and conclusions show that the principle of energy conversion was accomplished but the necessity for further study in the field of designing a more improved converter is indicated.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 32000010374

3201 Buildings

REFER ALSO TO CITATION(S) 3201009700, 9948, 10608

9999 (BFR-R—122-1983) Electric heating versus heat pumps for oil-fired small houses. Economic comparisons. Eriksson, T.; Qvist, B.; Westerlund, R. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 40p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750177.

Electric heating is compared with heat pumps for the substitution in oil fired small houses. The economical consequences are described. It is possible to reduce the cost of fuel import by 30 to 50 percent when using electricity and up to 80 percent when using ground source heat pumps. A calculation based on coal fired electric power plants by the year 2000 is presented. It is shown that reduction of energy needs is achieved by using heat pumps. On private financing electric heating seems to be the best solution in order to substitute for a yearly consumption of 4 m^3 light heating oil.

10000 (BFR-R—123-1983) Heat recovery from split exhaust air systems of a school in Malmoe. Sund, O. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 69p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750191.

The profitability of a heat recovery system has been evaluated. The system is made of 11 heat pumps which are used to heat the ventilation air of a schoolhouse at Malmoe. The heated area is 11760 m^2 and its original energy consumption was 275 kWh per m^2 per year as delivered by district heating. The heat pumps were installed to heat 130000 m^3 per h air intake and to deliver 24.5 kW per heat pump. The conservation effect has been recorded and the specific consumption of energy was lowered to 124 kWh per m^3 and year. The cost of the installation has been calculated and the savings were found to be 140 SEK per MWh. The profitability is shown to be dependent on operating-time. The Swedish market potential might amount to 14400 heat pumps; 720 GWh per year could be saved at an installation cost of 860 MSEK.

10001 (CONF-841231—3) Optimized ground coupled heat pump mechanical package. Catan, M.A. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016;AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004433.

From DOE/ORNL heat pump conference; Washington, DC, USA (10 Dec 1984).

The system which was optimized was a horizontal earth coil in a given house in the Pittsburgh area. The types of components used in the heat pump are essentially conventional. The method of this study is derived from one used to optimize an air-source heat pump for operation at standard steady state conditions. A computer model, created at Oak Ridge National Laboratory (ORNL), is used to predict heat pump performance for specified configuration and operating conditions. A predetermined set of design parameters is automatically altered by a constrained minimization program (a Numerical Algorithms Group library routine hereafter referred to as the optimizer) to find the combination for which the highest COP is predicted by the heat pump model. In the present study, the set of parameters to be varied include some pertaining to the ground coil as well as some pertaining to the heat pump. The optimizer, in this case, pursues a minimum life cycle cost which is calculated using the heat pump model, a ground coil model (called FTECM for Fast Transient Earth Coil model), and a parameterized cost model. The flow chart shows how the optimizer interacts with these programs to minimize life cycle cost.

10002 (CONF-8410153—5) Cooling performance improvements of a horizontal ground coupled heat pump. McGraw, B.A.; Baugh, R.N.; Johnson, W.S.; Griffith, W. (Tennessee Univ., Knoxville (USA). Energy, Environment and Resources Center). Oct 1984. Contract AC05-84OR21400. 13p. NTIS, PC A02. File Number DE85002470.

From 7. heat pump technology conference; Tulsa, OK, USA (15 Oct 1984).

Performance of the horizontal-coil ground-coupled heat pump system in TECH House I at the Tennessee Energy Conservation in Housing Facility is reported for the summers of 1983 and 1984. The overall coefficients of performance (COP) were 1.80 (1983 and 2.41 (1984) while the overall cooling seasonal performance factor (SPF) was 1.11 (1983) and 1.43 (1984) with the system located within the conditioned space. If the system had been outside the conditioned space, an SPF of 1.31 (1983) and 1.76 (1984) would have been realized. In both years, the systems were identical with the exception that prior to the 1984 cooling season, the ground coil was excavated and a new one of identical length was installed using sand as a backfill material. Although the 1984 SPF was 29% higher than that measured in 1983, the improvement cannot be totally attributed to the backfill material. During the summer of 1983, 30% more cooling degree days were incurred than in 1984. A decrease in runtime (as a result of lower ambient temperatures) would also increase the performance factor.

10003 (DOE/CE/64780—T1) [Energy consumption monitoring]. Quarterly progress report. (Unified Industries, Inc., Springfield, VA (USA)). 31 Dec 1984. Contract FG01-84CE64780. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004425.

Progress is reviewed briefly in preparation of information packet, contacts with states, and problem areas. (MHR)

10004 (DOE/CS/30345—1) Mennonite Nursing Home passive solar demonstration. (C.E. Associates, Corvallis, OR (USA); Merrill (Thomas W.), Albany, OR (USA); Mennonite Home, Albany, OR (USA)). Mar 1984. Contract FC02-80CS30345. 45p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85000430.

A long-term nursing care facility and retirement center was designed for passive solar heating. The system comprises thermal mass, thermal insulation, Trombe walls, and direct gain clerestories. Included here is a topical report, analysis of building performance, owner's perspective, designer's perspective, and summary of information dissemination activities. (MHR)

10005 **(DOE/CS/69105—5) Identifying low cost energy improvements for school buildings: an energy audit manual.** (Minnesota Dept. of Energy and Economic Development, St. Paul (USA). Energy Div.). 1984. Contract FG02-80CS69105. 95p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85003993.

This manual is a guide for identifying low and no cost opportunities to save energy dollars in school buildings. It is a workbook for school maintenance and administrative personnel to use to conduct a walk-through inspection of a school building, focusing on the energy efficiency of its equipment and operations. It is geared primarily toward buildings that house primary and secondary grades and community centers. Although it was written for public and private schools, other organizations with similar buildings, such as college classroom buildings, should also find the manual useful. Only energy conservation opportunities that have proven to be effective in schools are included in this manual. The energy conservation measures included here are based on a study of 39 school buildings that analyzed the effectiveness of mini-audits previously conducted on the buildings. The study found that carrying out a program of low and no cost conservation measures is effective in cutting energy use. The schools studied had reduced their energy consumption an average of about 10% by carrying out many of the measures identified in their original mini-audit. A mechanical engineer reaudited each building and found several opportunities that had not been identified in the previous audit. The study concluded that if the schools carried out all of the measures identified in the original mini-audit, as well as those identified in the second audit, even greater savings could be achieved.

10006 **(DOE/EIA—0458) Residential energy consumption and expenditures by end use for 1978, 1980, and 1981.** Johnson, M. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Dec 1984. 94p. NTIS, PC A05/MF A01; 1 - GPO; GPO Dep. File Number DE85003876.

The end-use estimates of the average household consumption and expenditures are statistical estimates based on the 1978, 1980, and 1981 Residential Enery Consumption Surveys (RECS) conducted by the Energy Information Administration (EIA) rather than on metered observations. The end-use estimates were obtained by developing a set of equations that predict the percentage of energy used for each broad end-use category. The equations were applied separately to each household and to each fuel. The resulting household end-use estimates were averaged to produce estimates of the average end-use consumption and expenditures on a national and regional basis. The accuracy and potential biases of these end-use estimates vary depending on the fuel type, on the year of the survey, and on the type of end use. The figures and tables presented show the amount and the type of energy cosumed, plus the cost of this energy. National averages are given as well as averages for various categories including region, size and age of dwelling, number of heating degree-days, and income. Some of the significant findings; energy trends by end use for all fuels used in the home for 1978, 1980, and 1981; and electricity consumption and expenditures and natural gas consumption and expenditures are discussed.

10007 **(DOE/R0/01363—T1) Great Alaskan warmup. Final technical report.** (Duszynski and Associates, Inc., Fairbanks, AK (USA)). 30 Jun 1984. Contract FG06-81R001363. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004502.

A project is detailed which involved superinsulating an existing house, adding a sunspace, and making a video which gives the public information on the project. The superinsulation consisted of building another shell 16 inches outside the existing one and filling the space with insulation. (MHR)

10008 **(EGG-M—21984) Magnetic refrigeration and heat pumping design options.** Kirol, L.D. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 21p. (CONF-8409186—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003405.

From Magnetic refrigeration workshop; Los Alamos, NM, USA (20 Sep 1984).

Magnetic cycles have potential for refrigeration and heat pumping from temperatures of 4°K or below to over 500°K. Theoretical studies have repeatedly indicated that demagnetization refrigeration has significant potential advantage over gas expansion or vaporization refrigeration. Tests of physical models have shown that there are many design problems to be overcome. However, these tests have not exposed any fundamental reasons why high efficiency and capacity predicted by analysis cannot be realized. Adequate solutions to all design problems have not been found, and practical machines have not been demonstrated. Continued study, testing, and exchange of ideas is necessary for rapid development of this technology. Most studies conducted to date have focused on a single magnetic refrigerator design concept and on problems associated with that configuration. This paper is a brief, general discussion of performance considerations and design options. Concepts discussed should be applicable to the entire range of possible cycle temperatures, although most results and conclusions are derived from high-temperature magnetic heat pump studies at the Idaho National Engineering Laboratory.

10009 **(N—84-20727) Late developments in the field of heat recovery.** Mcfarlan, A.I. (Lehigh Univ., Bethlehem, PA (USA)). 1983. 26p. NTIS, PC A14/MF A01.

In South African Inst. of refrigeration and air conditioning, frigair 1983: papers, 26 p., N—84-20717 11-31.

Developments to reduce the first cost and operating expense of large building air conditioning systems, with emphasis on heat transfer are described. The 3 pipe wide range coils dissipate part of the summer cooling load directly to the outside of the building without passing thru the water chillers. Tank circuits to automatically cycle water thru storage tanks can reduce the refrigeration load about 35% during the peak day period. Means to produce above 48.9 C hot water economically for winter heating and summer dissipation of internal heat are described. A heat balance is maintained automatically to remove only the excess winter heat beyond that which can be usefully recycled or stored.

10010 **(N—84-25532) Department of Housing and Urban Development-Independent Agencies Appropriations Act, 1985.** (Committee on Appropriations (U.S. Senate), Washington, DC). 1984. 53p. US Capitol, Senate Document Room, Washington, DC.

The text of an act making apropriations for the Department of Housing and Urban Development and sundry independent agencies, boards, commissions, corporations, and offices for the fiscal year ending September 30, 1985 is given. Money is appropriated for rent supplements, housing counseling Solar Energy and Energy Conservation Bank, urban homesteadng, American Battle Monuments, Commission, the Consumer Product Safety Commission, the Environmental Protection Agency, and other agencies and programs.

10011 **(NBSIR—84-2917) Environmental cycling of cellulosic thermal insulation and its influence on fire performance.** Lawson, J.R. (National Bureau of Standards, Washington, DC (USA). Center for Fire Research). Aug 1984. Contract AI05-78OR06113. 46p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004295.

A study was conducted on climatological data for eleven cities located throughout the United States. Findings from this environmental study were used to develop conditioning cycles for a research project on the influence of environments on the fire performance of loose-fill cellulosic thermal insulation. Six cellulosic insulation materials with different compositions of fire retardant chemicals at an add-on level of 25% by weight were specially manufactured for this study. These materials were tested for fire performance using the smoldering combustion test and the attic flooring radiant panel test to establish a baseline. After the materials were exposed to the various environmental cycles, they were tested for fire performance. Results from these tests show that environmental exposure can have a significant effect on the fire performance of cellulosic insulation materials and indicates that long term fire protection provided by fire retardant compounds may be limited.

10012 **(NP—5750138) Dynamic testing of water/water heat pump.** Olsen, T. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Koeleteknik). Dec 1983. 75p. (In Danish). Teknologisk Instituts Forlag, Taastrup, Denmark. File Number TI85750138.

EFP-80.

In this project a testrig, capable of testing water/water heat pumps operating both in steady state and dynamic mode, has been designed. During the dynamic testing the variations in temperatures on both the cold and warm side, are simular to the variations observed when the heat pump is operating in a house. In the report a method of reducing the large amount of data related to dynamic testings is presented. Quantities, which are to be considered characteristic in the dynamic mode, are proposed. Further the term Dynamic losses is defined. A number of tests have been carried out on the testrig in order to study the dynamic performance of a heat pump operating under varying loads. It has been found, that the dynamic losses increases as the load decreases. The importance of proper heat pumps sizing is demonstrated, in particular oversizing is to be avoided. Finally a number of areas, where one could apply the results obtained in the project, are pointed out. For example it is possible to make more precise computer simulations of heating systems including heat pumps, if one has the results of the dynamic test of the heat pump. By applying the described method, it is possible to test heat pumps already installed in houses, were it is rather impossible to establish the conditions needed when making steady state tests.

10013 **(NP—5750149) Development of an accumulating, water-based electric heating system with control system.** (NESA A/S, Hellerup (Denmark)). Apr 1984. 46p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750149.

Part 1 of the report deals with the dimensioning, installation and testing of a heating system designed for partly electric storage heating. The system is installed in a single-family house at Glostrup. The system is dimensioned to cover the heat loss of the house down to an outdoor temperature of +2degC by electric storge heat supplied according to low-load rate. At temperatures below +2degC supply of supplementary heat can possibly be affected in the day hours according to high-load rate. The testing of the system showed that this is working satisfactorily, and that during the test period the whole heat consumption of the house had been covered by electric storage heating. However, on the basis of the actual prices of electricity and oil the installation of systems designed for partly electric heating will not be advantageous to private economy. Part 2 of the report deals with the development of a control system for control of storage charging and control of supplementary heat supply.

10014 **(NP—5750176) Earth heat for existing built up areas. Vertical systems in clay. Development and feasibility.** Jacobson, L. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Sektionen foer Arkitektur). 1983. 27p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750176.

In this thesis the feasibility of vertical systems in clay for use in existing, Swedish built up areas is discussed. Vertical earth heat systems use vertical pipes in the earth for collecting and storing heat thus reducing the land demand. The collected heat is adapted to space heating by means of a heat pump. From field and laboratory tests basic knowledge relevant to systems design was gained. Relevant data about existing buildings and built up areas were collected and preliminary dimensioning rules outlined. Then, different systems for proposed type houses and seven objects in the Gothenburg area were sketched and evaluated from the technical and economical point of view. From these studies and calculations, general results are obtained and a model for evaluating the suitability of existing built up areas for vertical systems in clay is proposed. The model is formed for use at different planning levels. The use of the model is tested on typical built up areas and buildings. Conclusions from the tests are that vertical earth heat systems in clay could be feasible for space heating in Swedish multi-family houses if the clay horizontal exceeds 20 metres. Taking into account environmental and aesthetic restrictions in built up areas it seems possible that more than 100000 apartments could be heated this way.

10015 **(SBI-MEDD—10) Energy consumption and energy-saving measures. An analysis of heat consumption in 53 public buidings in Aalborg.** Christiansen, M.; Moerk, P. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1982. 105p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750122.

An analysis of energy consumption, investment in energy-saving measures and energy conservation in some public buildings, mainschools and social institutions is based on 53 buildings in district town Aalborg, Denmark. Experience of the energy-saving program up-to-date is evaluated.

10016 **(SBI-MEDD—33) Domestic consumption of heat and hot water. Preliminary investigation.** Brorsen, S.; Pedersen, D.O. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1983. 53p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750120.

A preliminary investigation of heat and hot water use for housekeeping purposes reflects different economic factors and physical conditions affecting residential houses. Generally fuel price rises result in saving of heating, closing of rooms, better insulation and worse ventilation.

10017 **(SBI-R—148) Calculation of energy consumption in smaller houses.** Johnsen, K.; Nielsen, A. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1984. 79p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750134.

EFP-80.

The present report describes a simple method af calculating net energy consumption in single-family houses and comparable buildings. Unlike the widely used degree-day method the present method allows for internal heat gains, heat from solar radiation, and the capacity of the house to accumulate heat. In spite of these important advantages the method is so simple that the calculation can be made manually. According to the main principle of the method the heat loss from the house, internal heat gain, and solar radiation is calculated month by month. On the basis of the monthly values of these quantities maximum and minimum limits of the energy consumption, Qsub(max) and Qsub(min), are calculated and then the magnitude of the actual consumption between the two limits may be determined on the basis of the heat accumulating capacity of the house.

10018 **(SBI-R—152) Indoor climate in renovated courtyardgarden houses.** Valbjoern, O.; Jensen, O. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1983. 42p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750121.

EFP-80. 5 refs.

The Danish Building Research Institute and the consulting firm I-68 have made an investigation in connection with the renovation of 1463 single family houses situated in Albertslund. The purpose was to measure any changes in temperature and humidity inside the houses and to record any changes in the residents' experience of the indoor climate. The investigation consisted of measurements of air temperature and humidity inside 38 houses during short periods of the winters before and after the renovation. During the same periods inquiry investigations took place. The inhabitants were asked to answer questions about their experience of the climate and about their use of the houses especially concerning window ventilation habits. The avarage room temperature measured was the same, approx. 22 deg. C, before and after the renovation. The average difference between the air humidity inside and outside the houses was reduced by 1.1 g water vapour per kg air (g/kg) from 3.5 g/kg before the renovation to 2.4 g/kg after the renovation. After the renovation there were fewer complaints about noise from outside, cold feet, draft, and cold air.

10019 **(SBI-R—153) Pressure conditions in flat roofs.** Nicolajsen, A. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1984. 41p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750143.

EM-2, EFP.

It has been the aim of the present project to develop a method of measuring pressure conditions within and immediately above a flat roof structure and to record pressure conditions in a number of roofs ventilated in different ways. The moisture contents in the roof structures were measured, and these measurements showed that, with the exception of the pressurized roof, too much moisture was absorbed in all structures, the moisture content exceeding the limit above which rot and fungal attacks may set in. In roof structures without ventilation it was impossible to arrive at a picture of the pressure conditions, as the measurements varied so much that no interpretation was possible. In ventilated roof structures the pressure was always lower than in the rooms below. The pressure difference varied throughout the structure on an average it was about 3 Pa during the winter when there are condensation hazards. In pressurized roof space the pressure was higher than in the rooms below, and the structure did not absorb moisture. However, this is an energy-consuming type of ventilation that cannot be generally recommended. The results of the examinations confirm that it is important to make airtight ceilings in order to prevent condensation in the roof spaces with the consequent absorption of moisture by any structural members of wood in the roof.

10020 **(SBI-R—155) Ventilation systems. Control, energy conservation and consumption.** Moerk, P.; Reinhold, C. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1984. 68p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750146.

EFP-80.

A general description is given of the control principles for the different components of a ventilation system, and the report states some possibilities of energy conservation control systems for the most common ventilation systems. A method for calculating the energy consumption of ventilation systems is described, and an example is given of how this report can be used to evaluate the possibilities for energy conservation measures at existing ventilation systems.

10021 **(SBI-R—159) Mobile laboratory for energy measurements. Experiences from investigations through three years.** Reinhold, C. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1984. 57p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750151.

EFP.

In 1980 the Danish Building Research Institute established a mobile laboratory for measuring and analysing energy consumption in large buildings. The objects of the laboratory are to develop methods for measurements and analyses of energy consumption in large buildings and to provide knowledge of defects and errors that cause too high consumption. The present report describes the objects and background of the mobile laboratory and the equipment and analysing-methods developed on the basis of experiences from investigations through three years. The report also surveys the experiences gained throughout this period as regard to typical defects and errors found in the buildings. Finally the report describes four examples for investigations performed by the mobile laboratory and the results gained by these investigations. A list of the most important equipment used by the mobile laboratory is given in the appendix. The experiences show possibilities of large energy savings by using check procedures and measurements as developed by the mobile laboratory even in well insulated and well operated buildings.

10022 **(SVF—138) Corrosion inhibitors for hot water systems. Final report.** Sundby, R.; Bergstroem, L.; Thoren, A. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Apr 1983. 62p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750198.

Alternative corrosion inhibitors for hot water systems have been studied. The investigation includes literature and market survyes, laboratory tests and pilot plant tests. Fifteen selected commercial inhibitors were tested for heat stability and corrosion protection in bench scale. Three of these products were then selected for continued tests in an autoclave loop at 120 degree for 2 months. Untreated tap water was used for the corrosion tests which meant corrosive but not unrealistic test conditions. The three selected inhibitors which were based on phosphonates, tannic acids and lignosulphonates reduced the corrosion rate to 50 - 65 percent at pilot plant corrosion tests. The acutal products have not been tested under less corrosive conditions as for example in water with a low oxygen content. The investigation has shown that inhibitor addition alone is not sufficient to prevent corrosion in aerated and corrosive hot water. The oxygen content of the water is the most important corrosion factor and degassing is therefore generally recommended.

10023 **(TNVP—82-03) Description of measurements and measuring equipment. Part report.** (Danske Elvaerkers Forenings Udredningsafdeling (DEFU), Lyngby). Aug 1982. 91p. (In Danish). Danske Elvaerkers Forenings Udredningsafdeling (DEFU), Lyngby.

EFP-80.

The Danish nationally sponsored heat pumps program consists of 9 subprojects. Subproject no. 2 concerning experience collected on the hitherto existing small heat pumps systems is presented in this report. Measurements were accomplished in 41 objects all over the country and consumer queries were collected and processed. Safety and economic aspects of heat pumps operation are evaluated. Measurements of energy consumption to heat respectively space and water and to run the auxiliary equipment (pumps, defrosting etc.) are accomplished by means of water meter connected with electronic circuit and tape recorder. Heat pump types measured were: ground/water - for space and water heating, air/water - for space and water heating, and air/water - for water heating.

10024 **(TNVP—83-05) Description of systems being measured.** (Danske Elvaerkers Forenings Udredningsafdeling (DEFU), Lyngby). Mar 1983. 25p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750125.

EFP-81.

The object of the measuring program of the research project "Operatinal experiences of small heat pumps" is to obtain information of operational results in practice. The heat pumps in the program includes 7 heat pumps for space and water heating, 2 for space heating, and 1 for water heating. The heat pumps have been chosen so that they represent to most common types in use. This report contains a brief description of each heat pump and a diagram of the measuring set-up.

10025 **(TNVP—83-06) Measurements of heat pump systems. Results.** (Danske Elvaerkers Forenings Udredningsafdeling (DEFU), Lyngby). Apr 1983. 34p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750124.

Heat pump systems established in consumer dwellings have been controlled and measurement results compared for various pump types. Results are of pure practical type, opposite to research testing and thus affected by seasonal variations, heat distribution, etc. Energy factor is determined for ground/water and air/water heat pumps and some "roof-coils" with brine. Energy consumption of the hot-water producing pumps is 3-4 kWh/day, its production is 3-5 kWh/ day. Heat pump economy has to be evaluated for water heating.

10026 **(OA-tr—1868) Progress of work at the Machines and Structures Department on compressors for use in heat pumps.** Deguerce, B.; Kleitz, A.; Tersiguel, C. (Overseas Relations Branch Translation Service, London (UK); Electricite de France, 92 - Courbevoie. Dept. Machines et Structures). Sep 1982. Translation source information not available . 4p. NTIS (US Sales Only), PC A02. File Number DE85900546.

Compressor tests and contract results are described briefly. (MHR)

3202 Transportation

REFER ALSO TO CITATION(S) 3202009976, 9977, 9978

10027 (AD-A—145088/1) Energy conservation: heating Navy hangars. Final report October 1979-September 1983. Ashley, J.L.; Correa, E.; Canfield, K. (Naval Civil Engineering Lab., Port Hueneme, CA (USA)). Jul 1984. 166p. (NCEL-TR—910). NTIS, PC A08/MF A01.

How energy is used for hangar heating and what methods are used to reduce hangar thermal energy consumption were investigated. The results of measurements of hangar air infiltration and stratification, two major causes of heating-related energy consumption, are reported. Methods to reduce this type of energy consumption (reduction of air infiltration and installation of destratifiers, vehicle access doors, door seals, vinyl strip doors, and radiant heating) were evaluated and are discussed. Design criteria providing hangar air infiltration rates versus hangar size and climatic conditions and design criteria for hangar destratifiers were developed and are presented. Energy Monitoring and Control Systems (EMCS) for saving cooling and heating energy are discussed.

10028 (NP—5750114) Spoilers for trucks. (Jydsk Teknologisk Institut, Aarhus (Denmark)). Feb 1984. 59p. (In Danish). Jydsk Teknologisk Institut, Aarhus, Denmark. File Number TI85750114.

EFP-82.

Fuel economy of trucks as a function of spoiler shape and size was investigated on models 1:30 in a wind tunnel and full-scale on a test road. A moderate investment in spoilers resulted in significant fuel economy, especially for high-shaped trucks, and high velocities. There is presented a diagram of saving depending on driving velocity and height of the spoiler.

10029 (PB—84-230119) Evaluation of large diameter propellers in tunnel stern merchant ships. Final report August 1981-May 1983. Robinson, J.H. (David W. Taylor Naval Ship Research and Development Center, Bethesda, MD (USA). Ship Performance Dept.). Feb 1984. 49p. NTIS, PC A03/MF A01.

As part of a broad program to seek hydrodynamic related improvements to effect energy savings in future U.S. Flag merchant ships, an evaluation of the potential of large diameter propellers in tunnel sterns was pursued. This embraced paper studies to relate potential improvement to ship type, size, and power, etc., and to develop design guidance. This was followed by model testing of two alternate afterbodies to an existing high-powered MARAD-developed containership. Experiments included propulsion and flow visualization for both designs and a wake survey for one. The results of the resistance and propulsion tests showed 4 and 8% reductions in delivered power at design speed over the parent single screw hull, for the two alternates, with 6 and 10% reductions relative to the conventional twin screw parent. Powering performance as well as goodness of flow favored a bulbous stern model over exposed shaft and strut configuration. The wake survey made for the bulbous stern model showed marked and potentially favorable changes from the conventional single screw parent.

10030 (PB—84-230143) Propulsion experiments with tandem propellers designed for large high speed cargo ship. Interim report October 1981-June 1983. Lin, A.C.M. (David W. Taylor Naval Ship Research and Development Center, Bethesda, MD (USA). Ship Performance Dept.). Aug 1983. 41p. NTIS, PC A03/MF A01.

A program for investigating hydrodynamic aspects of energy conservation for commercial ships is in progress at the David Taylor Naval Ship R and D Center (DTNSRDC). As part of this program, the propulsion performance of the MARAD high speed container ship model 5218, with design tandem propellers, was measured with both a transmission dynamometer and in-hub dynamometers in separate experiments. A comparison between the two experimental results shows very close agreement. The individual thrust and torque contributions of the forward and aft propeller were determined and compared to the design target thrust and torque. The design tandem propeller showed a 4.4 percent decrease in delivered power relative to the stock tandem propeller and a 6.6 percent decrease relative to the prognosis for design of a single screw configuration.

10031 (PB—84-230168) Cavitation experiments with tandem propellers designed for large high speed cargo ship. Interim report October 1981-March 1983. Anderson, K.J. (David W. Taylor Naval Ship Research and Development Center, Bethesda, MD (USA). Ship Performance Dept.). Mar 1983. 54p. NTIS, PC A04/MF A01.

As part of a Maritime Administration project in energy conservation, the David Taylor Naval Ship Research and Development Center (DTNSRDC) has been tasked to design and evaluate a set of tandem propellers for a high-speed containership (Model 5218). This report presents the results of open water and cavitation experiments for these design tandem propellers. A conventional single propeller was also evaluated at the design conditions for this ship. A comparison of these propellers showed that the tandem set had a higher peak efficiency and slightly more cavitation than the single propeller at design conditions. When compared to other commercial ship designs, the amounts of cavitation observed on both the tandem and conventional propellers are considered acceptable.

10032 (PB—84-234582) Energy saving traffic operations project guide: estimating traffic operations benefits. Final report. (Barton-Aschman Associates, Inc., Evanston, IL (USA)). May 1981. 76p. NTIS, PC A05/MF A01.

Sponsored in part by Illinois State Dept. of Transportation, Springfield.

This report describes simplified procedures for estimating changes in fuel consumption, travel time and CO emissions expected to result from common traffic operational improvements. Included are charts and graphs that can be used to estimate such changes for 10 basic traffic improvement plans which are frequently proposed by traffic and transportation engineers. The 10 improvement plans include adding left-turn lanes, various traffic signal modifications, and improving rough railroad at-grade crossings. The report itself is designed for use by practicing transportation engineers, although the results of their analyses should be useful at the policy level.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 3203009498, 9499, 9500, 9502, 9972, 10008, 10039

10033 (N—84-20728) Investigations into the use of ice for cooling deep mines. Sheer, T.J. (Chamber of Mines, Johannesburg (South Africa)). 1983. 15p. NTIS, PC A14/MF A01.

In South African Inst. of refrigeration and air conditioning, frigair 1983: Papers, 15 p., N—84-20717 11-31.

The feasibility of using ice for cooling deep mines as an alternative to sending chilled water underground was considered. It is indicated that for sections of a mine at depths greater than 3,000 m below surface, the total present value cost of a cooling system based on the use of ice would be equal to or even less than that of a chilled water system in corporating surface refrigeration plant and energy recovery turbines. For an ice system to be a practical proposition, methods must be developed to transport such large quantities of ice to storage dams underground.

10034 (NP—5750117) Natural gas applied to direct drying of food. Rubin, J.; Porsdal Poulsen, K. (Danmarks Tekniske Hoejskole, Lyngby). 1983. 65p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750117.

In direct drying the process air is heated by mixing in hot flue gas, whereas by indirect heating the air is heated in a heatexchanger by flue gas or a heating medium. Energy consumption for direct drying is 10-40% lower than for indirect and investment costs considerably less. Further, direct drying equipment is normally quicker reacting than indirect, and shorter start-up and close-down phases may be gained. Natural gas is in general regarded as a very clean source of energy. Even so questions have been raised

that foods produced by direct drying utilizing natural gas may be contaminated by the contact with especially the nitric oxides of the flue gas. The survey showed that for many food products direct drying does not add to eventual contaminations. By direct drying of food products such as milk powder and malt low level contaminations of the food with nitrite/nitrate and N-nitrosamines have been found. By use of low NOsub(x) burner types instead of conventional burners the concentration of nitric oxides in the flue gas can be reduced 5-100 times. The contaminations caused by the direct drying process will thereby be at such a level that it can not significantly be distinquished from that of other sources.

10035 **(NP—5750152) Automatic burner adjustment in a singeing oven.** Aabo, P. (Slagteriernes Forskningsinstitut, Roskilde (Denmark)). Jul 1984. 20p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750152.

The expected energy savings of 10-15% of the actual fuel consumption in the singeing oven was reduced because of the change in the design of the singeing oven itself. The socalled optimized singeing oven hereafter includes: ceramic fibres, combustion air from the ceiling, fireproof oven bottom, automatic adjustment of air and fuel, rapid opening and closing, change over to pilot flame during stops and the slaughter line, and sealing between the oven's two parts and bottom. This optimization of the design of the singeing oven reduces the oil consumption from 0.8 litre to 0.45 litre fuel per pig carcass. The described optimization of the oven is partly carried out during this project. Thus the starting point for further reduction of the energy consumption is changed rather much. Neverthless a calculation of prospective profits proves that it is still profitable to invest in equipment for adjusting the burner in the singeing oven. It has been proved that the degree of singeing can be controlled by the parameters singeing period and oven temperature. A control device for controlling of the oil consumption on the basis of the temperature of the waste gas has succesfully been installed and it has been proved that the pay back period for this control device is approximately 2 years.

10036 **(PB—84-234657) Overview of 'who is doing what' in laboratory- and bench-scale hazardous waste incineration research.** Lee, C.C.; Huffman, G.L. (Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab.). Aug 1984. 112p. (EPA/600—D-84/209). NTIS, PC A06/MF A01.

This paper summarizes and compares five past and eight current research studies in the area of laboratory- and bench-scale hazardous waste incineration research. The subjects covered range from non-flame to turbulent flame thermal destruction, and from conventional to innovative incineration processes. As a conclusion, this paper provides: Information summarizing the thermal destruction testing results for various hazardous waste compounds. Recommendations regarding future directions in the area of hazardous/toxic waste thermal destruction research.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 3206009967

10037 **(AD-A—145181/4) Investigation of tri-service heat distribution systems (modernization of existing underground heat distribution systems). Final report.** Segan, E.G.; Chen, C.P. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jun 1984. 176p. (CERL-TR-M—347). NTIS, PC A09/MF A01.

The objective of this research was to evaluate the physical condition of prefabricated steel conduit underground heat distribution systems built in accordance with the Tri-Service Specifications for Underground Heat Distribution Systems (Army, Navy, and Air Force documents CE-301.21, TS-F28g, and Air Force Pamphlet No. 88-007-1, respectively) and to recommend changes to new specifications as necessary. Other types of heat distribution systems were also inspected where convenient. The objectives were met by conducting field surveys at eight Department of Defense (DOD) installations; a total of 66 sites were inspected. The results were compiled and the performance of systems as a function of site classification was assessed. The results of this investigation were; (1) Specific problems with prefabricated steel conduit systems were observed and discussed; (2) Problems with the prefabricated steel conduit systems were attributed to deficiencies in design, construction, and maintenance of the systems; (3) Deficiencies in following established guidance contributed to problems with conduit systems; and (4) A need exists for additional guidance for the design, construction, and maintenance of conduit systems.

10038 **(ANL/CNSV-TM—148) Evaluating options and plans in community energy programs: an introduction.** Kron, N.F. Jr.; Tschanz, J.F. (Argonne National Lab., IL (USA)). Mar 1984. Contract W-31-109-ENG-38. 142p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85004827.

Communities undertaking energy planning projects have been faced with a serious problem: although very good methods exist for organizing an energy program and conducting a community energy audit, relatively few methods are known for systematically evaluating the energy options being weighed for possible action by the community. The increased need to justify energy activities in terms of their economic, environmental, social, energy-saving, and other merits requires both quantitative and qualitative evaluation methods that will answer vital questions asked by community leaders. This report (1) presents a theoretical structure for conducting evaluations of energy options and plans; (2) identifies readily available methods for making those evaluations on a community-wide basis, and serves as a reference guide for further research by community planners on the subject; and (3) recommends areas where further local and federal research would be of greatest value. The report is part of the multivolume Comprehensive Community Energy Management Program (CCEMP) methods series.

10039 **(BFR-R—51-1983) Waste heat recovery with heat driven heat pumps at Billesholm.** Morawetz, E.; Baeckstroem, P. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 69p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750190.

A study has been made, on the technical and economic possibilities to use waste heat from a local industry to a small district heating system at Billesholm, Sweden. Waste heat is available as cooling water with a temperature of 25-45 degrees C. The top load of the heating central would be 2.5 MW, and the yearly heat demand about 5100 MWh. Three different designs are studied, all including a natural gas boiler: 1) a gas driven absorption heat pump, 2) a steam driven absorption heat pump, 3) two gas motor driven (compressor) heat pumps. The investment and operation cost for these alternatives are calculated, and compared to an earlier study of an electric heat pump installation. With energy prices as of today the first alternative is most economic, i.e., a gas driven absorption heat pump.

10040 **(CONF-8405261—1) Small scale cogeneration, a unique opportunity.** Parker, S.A.; Thompson, C.R.; Froneberger, R.L.; Turner, W.C. (Oklahoma State Univ., Stillwater (USA). School of Industrial Engineering and Management). 1984. 8p. Public Relations, Institute of Industrial Engineers, 25 Technology, Atlanta-Norcross, GA 30092. File Number TI85900229.

From Annual conference of the Institute of Industrial Engineers; Chicago, IL, USA (6 May 1984).

This paper is designed to develop a basic understanding of cogeneration as it applies to small applications. Recognizing that there is a large potential for cogeneration systems 500 kW and smaller, this paper is designed to aid the plant engineer in the basic understanding and application of small scale cogeneration. The paper presents the basic legal, environmental and technical factors that should be considered. Then, an economic analysis is presented. The paper concludes with a hopeful outlook on the future of small scale cogeneration.

10041 **(DOE/CE—0118) DOE state and local assistance programs. Program activities, 1984 report.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). Oct 1984. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85005144.

Progress is reported on the following state and local assistance programs: state energy conservation, Energy Extension Service, weatherization assistance, institutional conservation, energy-related inventions, and appropriate technology. Grants provided in FY 1984 are tabulated. (MHR)

10042 (LUTMDN/TMVK—3117/1-32) Pass-out condensation turbines of large heat pumps as heat source of a system for district heating. Borglin, S. (Tekniska Hoegskolan, Lund (Sweden). Institutionen foer Vaerme- och Krafteknik). May 1983. 33p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750161.

Many district heating systems in Sweden have been supplemented by large heat pumps driven by electric motors. Electric boilers are also used. In order to supply sufficient electric power, large coal fired power plants are to be constructed. Several types of heating systems are discussed. The evaluation of a system can be based upon its dependence on thermodynamic processes. The procedure of making comparisons of the systems with one another is described. A qualifying figure, called heating value, has been used in the calculations.

10043 (N—84-30558) Environmental effects of increasing the amount of district heating in the Netherlands. Hof, J.J. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). 1983. 14p. NTIS, PC A02/MF A01.

The environmental consequences of district heating systems are compared. It is concluded that district heating has advantages from an environmental point of view, with respect to heat discharges and air pollution. The thermal load can be reduced by district heating by 70 to 75% compared to separate generation, and SO2 emission can be reduced by 85 to 90%. The NO emission remains unchanged, because the present situation with natural gas, being by far the most important fuel, can hardly be improved. (ESA)

10044 (SVF—135) Method for testing district heating pipes. Rundstroem, T. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Apr 1983. 23p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750195.

A proposal for a district heating pipe standard test method is submitted in the report. The test method is applicable to preinsulated pipes made of inner steel tubes, polyurethane foam insulation and polyethylene outer jackets. It is proposed that the pipes are to be tested under field conditions, where temperature cycling loads and heat loss measurements are the main considerations. The proposition is based on experiences from earlier field tests of district heating pipes, accomplished at Studsvik. The supplementary test analysis is mainly a check of demands according to 'Technical Delivery Stipulations' by the Swedish District Heating Association. Additional laboratory tests are needed before the proposed test method can be confirmed as a standard method for testing district heating pipes.

10045 (SVF—136) Method for testing district heating pipe jacket joints. Rundstroem, T. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Apr 1983. 24p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750196.

The principles of a proposal for a standard test method of district heating pipe joint evaluations is submitted in the report. The test method is applicable to jacket joints for preinsulated pipes made of inner steel tubes, polyurethane foam insulation and polyethylene jackets. It is proposed that the joints are to be tested in a sand box where they are submitted to a great number of displacement cycles. Extra soil filling is simulated by a top load on the sand surface. Outer leakage control and measurement of joint displacement relative to the jacket are included in the test. The influence of thermal aging and sunshine exposure on the jacket joints strength is proposed to be investigated. Fundamental sand box and laboratory tests are needed before the proposed method can be confirmed as a standard test method for district heating pipe jackets joints.

10046 (SVF—141) Availability and reliability of alarm systems. Rundstroem, T. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Oct 1983. 47p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750201.

Electronic alarm systems supervising the insulation moisture contents in pre-fabricated district heating networks were investigated during 1982. As a first stage alarm system statistics were collected by inquiries to members of the Swedish District Heating Association (VVF). Availability and reliability of alarm systems have been studied in a second stage by means of measurements and function controls. The mean alarm unit availability was found to be 65 per cent for 93 alarm units from four different manufacturers represented in proportion to the collected statistical data. 19 percent of the units were malfunctioning because of electronic failures and 16 percent because of trifle faults. The alarm system reliability is affected mainly by several unjustified alarms caused by short-circuits and alarm wire ruptures in the pipes. 33 percent of all alarms during 1981 were estimated as unjustified alarms. The figure is verified by results from measurements 1982, where the moisture failure rate was found to be 0.26 per supervised section compared with the total failure rate 0.43. For increasing alarm availability it is primarily proposed that function controls are undertaken. Control methods are discussed for both existing alarm units and new installations, as well as for periodical routine controls.

10047 (SVF—142) Energy conservation effect on the production of energy in a district heating system. Mattsson, C.; Jacobsson, B. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Oct 1983. 52p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750202.

The subscribers energy conservation measures in a DH-system have different effects on the load curve. Actions as additional insulation, gives fundamentally the same savings in per cent during the part of the year when the heating is demanded. The economies of the subscribers and the heating suppliers are also influenced with a different degree of energy conservation in the DH-system. With the present DH-tariffs (flexible part during the year, based on the price of heavy oil) most of the energy saving measures are favourable to the subscribers. When changing over to solid fuels (coal, for instance), the marginal cost tariff is the flexible part during the summer based on the valid price of coal. With governmental loans for energy conservation purposes, more expensive measures, for instance additional insulation, might be profitable for a subscriber with DH. Most of the present construction of tariffs do not have any influence on the energy suppliers economical situation regarding energy savings at a limited number of subscribers in an older, now existing DH-net. In a DH-net under construction the energy conservations are limited to a certain level over which DH of the same area is not profitable. At a sufficiently low heating demand, the heat supplier will not be able to cover his costs, regardless if the alternative tariffs are being used.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 32090010006

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 33000010118

3301 Internal Combustion Engines

10048 (AD-A—144425/6) Computer aided data acquisition and control of an internal combustion engine. Master's thesis. Oakes, B.R. (Naval Postgraduate School, Monterey, CA (USA)). Mar 1984. 107p. NTIS, PC A06/MF A01.

Two microcomputers, a Digital Equipment Corporation VT-103 and an Octagon Systems Corporation SYS-1, were interfaced with a General Motors Model 1-53X3 single cylinder diesel engine to provide automated data acquisition and data reduction and

engine control while running classroom experiments. Engine inlet and exhaust temperatures and pressures, RPM, torque and fuel flow along with additional engine parameters can be measured with the aid of a computer. Values for parameters such as specific fuel consumption, air-to-fuel ratio, and thermal efficiency can then be computed and both measured and computed values can be displayed and recorded. The Digital Equipment Corporation Computer is the parent computer and is used interactively for data acquisition and data reduction and for feedback control through the Octagon computer to which it is linked. The Octagon computer is used exclusively for control of the engine speed and load.

10049 **(N—84-20538) Numerical modeling of turbulent flow.** Claus, R.W. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1984. 1p. NTIS, PC A14/MF A01.

In Combustion fundamentals research, 97, N—84-20525 11-07.

Three dimensional combustor calculations are currently stretching the computer hardware capabilities and the computing budgets of gas turbine manufacturers. One of the main reasons for this relates to the large number of complex physical processes occurring in the combustor. Airflow, fuel spray, reaction kinetics, flame radiation, and not the least of which, turbulence must be modeled and the related differential equations solved. Discussions in this conference will address methods to improve the accuracy of combustor flow field calculations and methods to speed the convergence of the modeled equations. This report will focus on aspects of merging these two new technologies. The improved accuracy discretization schemes have a negative impact on the speed of convergence of the modeled equations that the improved solution algorithms may not overcome. A description of the causes of this problem and potential solutions will be examined.

10050 **(N—84-24753) Optical measurements of soot size and number density in a complex flow, swirl-stabilized combustor.** Samuelsen, G.S.; Wood, C.P.; Jackson, T.A. (California Univ., Irvine (USA)). Jan 1984. 15p. NTIS, PC A19/MF A01.

In AGARD combustion problems in turbine engines, 15 p., N—84-24732 15-25.

In-flame optical measurements of soot particulates in a turbulent, recirculating (i.e., complex flow) model laboratory combustor are described. A nonintrusive optical probe based on large angle (60 deg, 20 deg) intensity ratio scattering was used to yield a point measurement of particulate in the size range of 0.08 to 0.38 micrometers. The performance of the optical technique was evaluated, and an exploratory assessment of the spatial distribution of soot was conducted with attention to fuel molecular structure, fuel loading, and a smoke-suppressant additive (ferrocene). Isooctane and mixtures of isooctane with various ring and aromatic compounds blended to yield the smoke point of a JP-8 stock were prevaporized and introduced through a hollow cone nozzle. The addition of ring compounds to the base isooctane substantially changed the distribution of soot and increased the overall emission by 300%. The production of soot was substantially reduced by a decrease in fuel loading, and marginally reduced or not affected by the additive depending on fuel structure. The optical technique is a potentially powerful tool for providing the experimental evidence necessary to understand the processes of soot formation and burnout in complex flows typical of gas turbine combustors. However, scanning electron micrographs of extracted sample established that the technique is limited to the large particle wing of the soot size distribution, and optical and electronic processing can induce biasing and uncertainties which must be understood and controlled before the potential of the technique can be fulfilled.

10051 **(N—84-26484) Real-time simulation of an automotive gas turbine using the hybrid computer. Final Report.** Costakis, W.; Merrill, W.C. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1984. 26p. (NASA-TM—83593; E—1994). NTIS, PC A03/MF A01.

A hybrid computer simulation of an Advanced Automotive Gas Turbine Powertrain System is reported. The system consists of a gas turbine engine, an automotive drivetrain with four speed automatic transmission, and a control system. Generally, dynamic performance is simulated on the analog portion of the hybrid computer while most of the steady state performance characteristics are calculated to run faster than real time and makes this simulation a useful tool for a variety of analytical studies.

3303 Electric-powered Systems

10052 **(DOE/CS/50208—1) Electric and hybrid vehicle demonstration project. Final report.** (Air Force Logistics Command, Wright-Patterson AFB, OH (USA)). 1984. Contract AI08-80CS50208. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003939.

The purpose of this demonstration program was to utilize 15 electric vehicles at three AFLC bases and demonstrate their functional capabilities within the federal fleet. The electric vehicles (EV) were to perform functions usually accomplished by internal combustion vehicles (ICV). The electric vehicles (nine pickups and six vans) provided by Jet Industries, Austin, Texas, were conventional internal combustion powered vehicles with the 90 horsepower engine and gasoline tank replaced by a 30 horsepower electric motor and lead acid propulsion batteries. Charging stations were constructed on the using installations to allow the vehicles to charge overnight. Deep cycling was required to develop memory of batteries. The batteries required a regular maintenance program including equalizing charges, terminal inspection and cleaning to avoid corrosion damage to battery terminals, connectors and wires. Weak batteries in the pack formed hazardous hydrogen gas during charge causing two explosions at one of the using bases. This ultimately resulted in termination of the program. Other problems encountered during the program are listed.

10053 **(EGG-SE—6746) Electric vehicle test program: INEL transition qualification test plan.** Heiselmann, H.W.; Knauts, H.E. (Idaho National Engineering Lab., Idaho Falls (USA)). Nov 1984. Contract AC07-76ID01570. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85005171.

This test plan sets forth the requirements necessary to qualify the test facility and equipment installation at the INEL in order to continue DOE programmatic testing of electric vehicles. Briefly, dynamometer tests will be performed on the Electric Test Vehicle 1-2 (ETV1-2) at constant speeds of 35, 45, and 55 mph and for the schedule D driving cycle.

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 33040010054

3306 Vehicle Design Factors

10054 **(DOE/CS/54209—20) Feasibility demonstration of a novel, flat-belt, continuously variable transmission for automotive and electric-hybrid vehicle application. Final report.** Kumm, E.L. (Kumm Industries, Inc., Tempe, AZ (US)). May 1984. Contract AI01-78CS54209. 136p. (JPL—9950-945). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85004579.

The performance of the Kumm Flat Belt Continuously Variable Transmission (CVT) was determined over its design input speed, output torque, and speed ratio range. This report documents both the tests results and the design, fabrication, and assembly activities. A novel flat belt pulley concept is used in the CVT. This arrangement significantly reduces the required width of the pulleys and their actuators as compared to pulleys whose sheaves are moved axially by actuators to vary the belt radius ratio or pulley speed ratio. The operation of the flat belt pulley guideway discs positioning the belt by moving belt drive elements radially is shown.

3307 Emission Control

10055 **(PB—84-234046) Survey of gaseous pollutant emissions from tuned in-service gasoline engined cars over a range of road operating conditions.** Potter, C.J.; Savage, C.A. (Warren Spring Lab., Stevenage (UK)). 1984. 184p. (LR—447(AP)-M). NTIS, PC E10/MF E10.

See also PB84-204825.

The emissions of carbon monoxide, total hydrocarbons and nitrogen oxides from a sample of twenty in-service gasoline engined cars which had been tuned to the manufacturers' specifications have been determined on the road using the WSL exhaust gas proportional sampler. Fuel consumptions were determined by carbon balance. The highest carbon monoxide and total hydrocarbon emissions occurred during urban drives in the average speed range about 17 to about 22 kph. As the average speed increased these emissions reduced rapidly, but above approximately 80 kph the carbon monoxide emissions started to rise again. The tendency for emissions to rise at speeds above 80 kph was much less marked in the case of total hydrocarbons. The variation of nitrogen oxides emissions with average speed was not consistent, however, emissions at 113 kph could be similar to or up to 2.4 times the urban value. The on-the-road emission factors determined in this survey have been used to provide an example of estimations of vehicle emissions on a vehicle activity disaggregated basis. (Copyright (c) Crown Copyright, December 1983.)

3308 Alternative Fuels

10056 **(DOE/NBB—0067) Research and development of neat alcohol fuel usage in automobiles.** Pefley, R.K.; Browning, L.; Espinola, S.; Pullman, B.; Gururangan, R.; Saito, N. (Santa Clara Univ., CA (USA). Dept. of Mechanical Engineering). Jun 1984. Contract AI01-77CS51044. 145p. (DOE/NASA—0143-1; NASA-CR—174813). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85005223.

The following aspects of alcohol usage in automobiles are covered: computer modeling of engine processes, engine cold starting by experimentation, vehicle and allied engine studies, corrosion and wear mechanisms, and photochemical smog studies.

36 MATERIALS

REFER ALSO TO CITATION(S) 3600009430

10057 **(UCID—19605-84-2) Metal finishing and vacuum processes groups, Materials Fabrication Division progress report, March-May 1984.** Dini, J.W.; Romo, J.G.; Jones, L.M. (Lawrence Livermore National Lab., CA (USA)). 11 Jul 1984. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001079.

Progress is reported in fabrication and coating activities being conducted for the weapons program, nuclear test program, nuclear design program, magnetic fusion program, and miscellaneous applications. (DLC)

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 3601009643, 9644, 9783, 9846, 9943, 10022, 10123, 10179, 10198, 10202, 10317, 10689, 10732

10058 **(BNL—35481) Microscopic magnetic structure of multiple bilayers of thin films of Fe and Ge.** Majkrzak, C.F.; Axe, J.D.; Boeni, P. (Brookhaven National Lab., Upton, NY (USA)). Oct 1984. Contract AC02-76CH00016. 18p. (CONF-841184—27). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004188.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

Multiple bilayers consisting of thin films of Fe and Ge with bilayer thicknesses down to 40 A were made by sputter deposition. It is found that the Ge layers are amorphous while the Fe layers are microcrystalline with [110] directions perpendicular to the plane of the substrate but with orthogonal directions in the plane randomly rotated about this axis. Neutron scattering measurements using a polarized beam were performed in order to study the Fe magnetism, particularly at the interface with the Ge. This data combined with X-ray diffraction data indicate a reduction in the moment of a fraction of the Fe atoms due primarily to interdiffusion at the interface.

10059 **(BNL—35482) Paramagnetic scattering from Ni.** Boeni, P.; Shirane, G. (Brookhaven National Lab., Upton, NY (USA)). Oct 1984. Contract AC02-76CH00016. 22p. (CONF-841184—22). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004207.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

New polarized beam measurements have been carried out in the paramagnetic phase of ^{60}Ni in order to enlarge the (q,ω) range previously studied by Steinsvoll et al. Magnetic scattering has been detected up to halfway to the zone boundary. The results can be successfully interpreted in terms of a diffusive type scattering function over an unexpected wide (q,w) range $q < 0.5A^{-1}$ and $\omega < 80$ MeV. The neutron data are also compared with the predictions of the very recent band model by Callaway. Finally, we point out important similarities and differences in the paramagnetic scattering from localized systems, such as EuO, and itinerant systems and discuss the universality of the paramagnetic scattering function.

10060 **(CONF-840767—11) TEM/FIM study of modulated microstructures in the Fe-Be system.** Miller, M.K.; Burke, M.G.; Brenner, S.S.; Soffa, W.A. (Pittsburgh Univ., PA (USA). Dept. of Metallurgical and Materials Engineering; Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005379.

From Microbeam Analysis Society analytical electron microscopy meeting; Bethlehem, PA, USA (16 Jul 1984).

Decomposition of Fe-rich Fe-Be alloys has been studied by a variety of independent techniques. However, there remains some uncertainty concerning the coarsening behavior of the decomposed structure. In this paper, a comparison of results of a combined transmission electron microscopy (TEM)/atom probe field-ion microscopy (APFIM) study of the development of the modulated microstructure is presented. In addition to the metallurgical aspects of this investigation, an important feature of this research is the emphasis on the application of AEM and FIM as complementary research techniques.

10061 **(CONF-840884—3) Relationship between symmetrical tilt, twist, special, and favored grain boundaries.** Wolf, D. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004024.

From International conference on the structure and properties of internal interfaces; Irsee, F.R. Germany (19 Aug 1984).

Within the framework of the coincident-site lattice (CSL) model, grain boundaries with the lowest values of Σ, the inverse density of CSL sites, are usually assumed to be special compared to high-Σ boundaries in that they are expected to show energy cusps. In this article the selection criteria for the identification of special or favored interface are investigated. Based on the observation that a symmetrical tilt boundary on a given crystallographic plane may be considered as the most special of all twist boundaries on this plane, two simple qualitative selection criteria are formulated. These criteria demonstrate that low values of Σ are a necessary but not sufficient condition for the selection interfaces. The most important physical parameters governing the energies of grain boundaries are shown to be (i) the spacing of lattice planes parallel to the boundary plane and (ii) the area of the planar (CSL) unit cell on the boundary plane.

10062 **(CONF-841157—37) HVEM investigation of in-situ self-ion damage in iron at 40 and 300°K.** Kirk, M.A.; Robertson, I.M.; King, W.E.; Ryan, E.A.; Philippides, A. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA). Materials Research Lab.). Nov 1984. Contract W-31-109-ENG-38;AC02-76ER01198. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004033.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

Bombardments of iron (commercially pure) with self-ions having energies of 50 and 100 keV were performed in-situ in a High-Voltage Electron Microscope at temperatures of 40 and 300°K. The resulting damage microstructures were examined at the irradiation temperature in the HVEM using 200, 300, 500 and 1000 keV electrons (damage threshold in Fe is ~ 330 keV). Dislocation loop densities were measured as functions of ion dose, ion energy, irradiation temperature, electron dose (500 keV), and step annealing to room temperature. Loop geometries, size distributions, and nature (interstitial or vacancy) were also determined.

10063 **(CONF-8408136—1-Draft) Electroreflectance spectroscopy as a probe of the electronic structure at the metal-electronic interface.** Ho, K.M.; Liu, S.H. (Ames Lab., IA (USA); Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400;W-7405-ENG-82. 6p. NTIS, PC A02/MF AO1; 1; GPO Dep. File Number DE85003541.

From International workshop on the electromagnetic response of surfaces; Cholula, Mexico (6 Aug 1984).

The electromagnetic response of a surface is influenced by the surface electronic structure. In particular, the existence of surface states in band gaps can lead to optical absorption below the bulk interband threshold. However, such effects are usually too small to be observed because while surface states are localized within several atomic layers near the surface, light waves can penetrate at least hundreds of layers into the metal. One way to enhance the surface effect for a metallic surface is to make use of electromodulation techniques. When a metal is placed in an electrolyte, an intense electric field (~ 10^7 volts/cm) can be induced at the metal-electrolyte boundary with the application of a bias voltage of less than a volt. Electroreflectance (ER) experiments modulate the bias voltage and measure the resultant modulations in the optical reflectivity. Since the static electric field is highly localized at the interface (the Fermi-Thomas screening length for typical metals is of the order of Angstroms) we expect the ER effect to be highly surface sensitive. Sensitivities in $\Delta R/R$ up to 10^{-6} can be achieved in such experiments. 12 references.

10064 **(DOE/ER/04254—6) Properties of supported metal catalysts. Final report.** Butt, J.B.; Burwell, R.L. Jr.; Cohen, J.B. (Northwestern Univ., Evanston, IL (USA). Ipatieff High Pressure and Catalytic Lab.). 1984. Contract AC02-77ER04254. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003927.

We have investigated all catalysts by WAXS as a function of pretreatment and some by SAXS. Studies of EXAFS and some studies of WAXS have been performed at CHESS. The hydrogenolysis of methylcyclopropane and the isotopic exchange between cyclopentane and deuterium has been studied on all catalysts and the hydrogenation of propylene and the isotopic exchange between deuterium and neohexane have been studied on Pt/SiO_2 and Pd/SiO_2. We have made detailed studies of the reaction of oxygen with reduced catalysts and of hydrogen with oxidized catalysts.

10065 **(EGG-M—14284) Temperature, velocity, and species mapping in an induction plasma.** Donaldson, A.D.; Batdorf, J.A.; Fincke, J.R.; Varacalle, D.J. Jr.; Richardson, L.S. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 9p. (CONF-841157—28). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004005.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

As part of an effort to determine the feasibility of carbothermic reduction of alumina in plasmas, spatial distributions of temperature, velocity and species in the plume of an argon radio-frequency plasma with alumina and carbon additions were estimated using a two-dimensional theoretical model of the flow field and a thermochemical model based on equilibrium conditions. Experimentally determined boundary conditions were input to the models. Using a 30 kW inductively coupled plasma, experimental measurements were made to allow comparison with predictions. A practical process for carbothermic reduction will require prevention of back reactions, either by separation of the aluminum species or by some kind of quenching of the process. The significance of the experimental results and comparisons with predictions are discussed.

10066 **(HEDL-SA—3196-FP) Effects of neutron irradiation on the fracture properties of HT-9 weld.** Huang, F.H.; Gelles, D.S. (Hanford Engineering Development Lab., Richland, WA (USA)). 8 Oct 1984. Contract AC06-76FF02170. 23p. (CONF-850211—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85001068.

From Annual meeting of the Society of Mining Engineers; New York, NY, USA (24 Feb 1985).

Fracture toughness tests were performed at 93, 205, 316 and 427°C using electropotential techniques on HT-9 weld material irradiated to a fluence of 2.35 x 10^{22} n/cm^2 (E > 0.1 MeV) at 390°C Testing of welds irradiated at 450, 500 and 550°C was performed at 205°C. Test results were analyzed using the J-integral approach. It was found that the fracture toughness of these HT-9 welds increased slightly, while the tearing modulus decreased significantly after irradiation to a fluence of 2.35 x 10^{22} n/cm^2. In addition, results showed that irradiation temperature had little effect on the fracture toughness of HT-9 weld metal. The specimens were examined by scanning electron microscopy after the test in order to understand the fracture process in this weld material.

10067 **(IS-T—1125) Thermodynamics of formation of intermediate phases in the yttrium-iron and yttrium-cobalt systems.** Subramanian, P.R. (Ames Lab., IA (USA)). Dec 1984. Contract W-7405-ENG-82. 80p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85005119.

Thesis.

Solid electrolyte electromotive force cells have been used to determine the Gibbs free energies, enthalpies and entropies of phase formation for Y_2Fe_{17}, Y_6Fe_{23}, YFe_3, and YFe_2 over the temperature range 893 to 1271°K. Solid CaF_2 was employed as the electrolyte. The enthalpies of formation of the Y-Fe phases lie between -6 to -9 kJ/gm-atom. Comparison of the experimental values for the Gibbs energies of formation of the Y-Fe phases at 973 K with those of the Th-Fe, Th-Co, Th-Ni, La-Co and La-Ni systems show an empirical correlation with the total number of bonding electrons in these alloy systems.

10068 **(IS-T—1137) Influence of the bcc to tetragonal transformation on superconductivity in La_3X_4 (X = S or Se).** Yeh, Y.C.S. (Ames Lab., IA (USA)). Dec 1984. Contract W-7405-ENG-82. 126p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85005206.

Thesis.

The lanthanum selenides and pseudobinary sulfides have been studied to investigate the influence of the bcc to tetragonal phase transformation on their superconducting properties. It was found that the suppression of this phase transformation improves the superconducting properties. The suppression is accomplished in this study by alloying with Th or substitution of S by Se. From the thermodynamic calculations, the values of $\Delta C/\gamma T$/sub c/, H/sub cz/(O) and kappa have been estimated. The high values of $\Delta C/\gamma T$/sub c/ indicate that the alloys studied in this work are strong-coupling. The high magnitude of the H/sub c2/(O) and kappa values shows that the materials are type-II superconductors.

10069 **(LBL—17747) Behavior of T/sub c/ of high temperature superconducting films and a determination of their parameters.** Kresin, V.Z. (Lawrence Berkeley Lab., CA (USA)). Sep 1984. Contract AC03-76SF00098. 6p. (CONF-840937—24). NTIS, PC A02. File Number DE85005167.

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

Existence of the proximity layer in Nb and NbN films leads to a peculiar dependence of the critical temperature upon the film thickness. Expressions describing T/sub c/ for S/sub α/-S/sub β/ and S/sub α/-N/sub β/ proximity systems are obtained. The theory allows to explain the dependence T/sub c/(L) which has been observed experimentally. Measurements of T/sub c/ can be used in order to determine the electronic density of states in the surface layer.

10070 **(LBL—18311) Combined surface science and catalytic studies of hydrocarbon reactions over platinum single crystal surfaces.** Zaera, F. (Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 334p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE85005162.

Ethylidyne, which forms during room temperature chemisorption of ethylene over Pt (lll), was shown to be stable towards rehydrogenation or deuterium exchange under atmospheric conditions. Ethylene hydrogenation over Pt (111) surfaces at near room temperature displayed kinetic parameters that agreed with those for supported catalysts, LEED, thermal desorption spectroscopy, and HREELS indicate the presence of ethylidyne on the surface after reaction. Exchange of ethane with D_2 over Pt (111) between 470° and 620°K gave an activation energy of 19 kcal/mole. The product distribution peaked at one (d_1) and six (d_6) deuterium atoms per ethane molecule, indicating two competitive mechanisms. A diffuse 2 x 2 LEED pattern suggested the presence of ethylidyne on the Pt surface, which can be easily hydrogenated to give d_6 ethane. Above 550°K, some hydrogenolysis was also detected, with turnover frequencies about three orders of magnitude smaller than for the exchange. Isobutane, neopentane, n-hexane and methylcyclopentane (MCP) conversion were also investigated over Pt surfaces of different orientations. Surface defects were important for the light alkanes but not for n-hexane or MCP reactions. Higher activities on stepped and kinked surfaces for the light alkanes correlated with patches of bare low coordination Pt atoms. The opposite was true for the heavier alkanes. A correspondence between this behavior and the different bond-shift and cyclic mechanisms was established. Potassium poisoned all n-hexane reactions due to an electronic interaction of the potassium with the surface. Rhenium, alloyed with Pt, increased the selectivity for hydrogenolysis. Sulfur over the latter system reduces all activity, but particularly methane formation.

10071 **(LBL—18682) Effect of grain size on the mechanical properties of dual phase Fe/Si/C steels.** Ahn, J.H. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004591.

For an Fe/2Si/0.1C steel with an intermediate quenching heat treatment, it was found that as the prior austenite grain size is refined, significant improvements in total elongation, reduction in area and impact toughness can be achieved, while uniform elongation, yield and tensile strengths are not affected. These improvements are analyzed in terms of microstructure and fracture characteristics. The cleavage cracks propagate nearly straight without deviation at the ferrite/martensite interfaces within the sub-units of the DFM structure, but change their path at high angle sub-unit boundaries. The crack is less likely to be deflected at the ferrite/martensite interface because the interface is coherent. Comparison of optical micrographs and SEM fractographs has shown that there is close agreement between the sub-unit size and cleavage facet size. The observations lead to the conclusion that the sub-unit size is the basic microstructure unit controlling the fracture behavior of DFM steels produced by the intermediate quenching heat treatment. A controlled rolling process was undertaken to obtain grain refined DFM steels. Results showed that this produces micro-duplex structures with attractive mechanical properties in an economicl way.

10072 **(N—84-32201) In-situ TEM investigations of graphic-epitaxy and small particles. Final Report, 1 January-31 December 1982.** Heinemann, K. (Eloret Corp., Mountain View, CA (USA)). Jan 1983. 68p. (NASA-CR—166593). NTIS, PC A04/MF A01.

Palladium was deposited inside a controlled-vacuum specimen chamber of a transmission electron microscope (TEM) onto MgO and alpha-alumina substrate surfaces. Annealing and various effects of gas exposure of the particulate Pd deposits were studied in-situ by high resolution TEM and electron diffraction. Whereas substrate temperatures of 500 C or annealing of room temperature (RT) deposits to 500 C were needed to obtain epitaxy on sapphire, RT deposits on MgO were perfectly epitaxial. For Pd/MgO a lattice expansion of 2 to 4% was noted the highest values of expansion were found for the smallest particles. The lattice expansion of small Pd particles on alumina substrates was less than 1%. Long-time RT exposure of Pd/MgO in a vacuum yielded some moblity and coalescence events, but notably fewer than for Pd on sapphire. Exposure to air or oxygen greatly enhanced the particle mobility and coalescence and also resulted in the flattening of Pd particles on MgO substrates. Electron-beam irradiation further enhanced this effect. Exposure to air for several tens of hours of Pd/MgO led to strong coalescence.

10073 **(N—84-33217) Proximity effects of superconducting multilayer film.** Xueyu, C.; Daole, Y. (Air Force Systems Command, Wright-Patterson AFB, OH (USA)). Jul 1984. 11p. (AD-A—143255; FTD-ID(RS)T—0717-84). NTIS, PC A02/MF A01.

The proximity effects of superconducting multilayer films composed of different metals are considered. The relationship between the critical temperature of a superconducting multilayer film with strong heterogeneity and its geometric structure is given.

10074 **(NAA-SR-TDR—12553) Low-cycle fatigue testing of irradiated Hastelloy-N (ORR S-2).** Krupp, W.E.; Johnson, L.L. (Atomics International, Canoga Park, CA (USA)). 28 Sep 1967. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004472.

Hastelloy-N strip specimens were irradiated in the Oak Ridge Research Reactor at temperatures of 1330 to 1390°F, to neutron doses of 1.8 to 2.6 x 10^{20} nvt thermal, 1.4 to 2.0 x 10^{19} nvt fast. Twelve irradiated specimens were selected for testing from each of two heats, 0143 (0.010 in. thick) and 5911 (0.015 in.). Six specimens in each heat were as-received, the other six were as-processed. Processing steps included chromizing, a simulated coating firing cycle, diffusion treatment, and straining to simulate tube straightening. In-cell fatigue tests were performed by reverse-bend cycling over mandrels of opposing radii at one cycle per minute, in helium, at 1400°F. The twelve specimens tested at strain ranges of 0.61 to 0.75% had an average fatigue life of 97 cycles. Only seven of the specimens tested at strain ranges of 0.31 to 0.37% failed; five remained intact after 25,000 cycles. The average fatigue life for all 0.31 to 0.37% specimens was 15,840 cycles, with no weighting factor used for intact specimens. Experimental results were four times greater than the predicted fatigue life at the higher strain range, fifty times greater at the lower. The Manson method for prediction of Hastelloy-N fatigue properties after irradiation appears valid for use in establishing design criteria.

10075 **(NAA-SR-TDR—12556) Determination of uniaxial mechanical properties of unirradiated and irradiated Hastelloy-N bar and biaxial stress-rupture properties of chromized and coated unirradiated Hastelloy-N.** Stearns, J.D. (Atomics International Div., Canoga Park, CA (USA)). 8 Sep 1967. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004471.

Short-time tensile tests were conducted on irradiated (2 x 10^{20} nvt) and unirradiated Hastelloy-N bar from heats 5911 and 6252. No significant difference in mechanical properties was noted between the two heats. The 1200°F ultimate tensile strength was decreased by irradiation from 65 to 80 ksi and 48 to 52 ksi. The 1400°F ultimate tensile strength was decreased from 45 to 51 ksi to 32 to 34 ksi. The yield strength was not greatly affected by irradiation at either 1200 or 1400°F. The 1200°F elongation at fracture was decreased from 15 to 45% to 5 to 11%. The 1400°F ductility was decreased from 8 to 26% to 1 to 1-1/2%. Unirradiated uniaxial stress-rupture tests were conducted at both AI and ORNL. No definite difference in stress-rupture properties between heats was noted at either 1200 or 1400°F in ORNL tests, although some of the 1400°F stress-rupture tests indicated that heat 6252 exhibited greater ductility. The AI verification tests showed a definite ductility difference, with heat 6252 exhibiting greater ductility. This phenomenon was attributed to an inhibition in crack propagation due to microsegregation.

10076 **(NUREG/CR—1408) Instrumented impact properties of zircaloy-oxygen and zircaloy-hydrogen alloys.** Garde, A.M.; Kassner, T.F. (Argonne National Lab., IL (USA)). Apr 1980. Contract W-31-109-ENG-38. 60p. (ANL—80-14). NTIS, PC A04/MF A01 - GPO. File Number TI85004740.

Instrumented-impact tests were performed on subsize Charpy speciments of Zircaloy-2 and -4 with up to ~ 1.3 wt % oxygen and ~ 2500 wt ppM hydrogen at temperatures between 373 and 823°K. Self-consistent criteria for the ductile-to-brittle transition, based upon a total absorbed energy of ~ 1.3 x 10^4 J/m^3, a dynamic fracture toughness of ~ 10 MPa.m/sup 1/2/, and a ductility index of ~ 0, were established relative to the temperature and oxygen concentration of the transformed B-phase material. The effect of hydrogen concentration and hydride morphology, produced by cooling Zircaloy-2 specimens through the temperature range of the $B \rightarrow \alpha'$ = hydride phase transformation at ~ 0.3 and 3 K/s, on the impact properties was determined at temperatures between 373 and 673 K. On an atom fraction basis, oxygen has a greater effect than hydrogen on the impact properties of Zircaloy at temperatures between ~ 400 and 600 K. 34 figures.

10077 **(NUREG/CR—2482-Vol.5) Review of DOE waste package program. Subtask 1.1. National waste package program, April-September 1983. Volume 5.** Soo, P. (ed.). (Brookhaven National Lab., Upton, NY (USA)). Aug 1984. Contract AC02-76CH00016. 118p. (BNL-NUREG—51494-Vol.5). NTIS, PC A06/MF A01 - GPO $5.00. File Number TI84017211.

The current effort is part of an ongoing task to review the national high-level waste package effort. It includes evaluations of reference waste form, container, and packing material components with respect to determining how they may contribute to the containment and controlled release of radionuclides after waste packages have been emplaced in salt, basalt, and tuff repositories. In the current Biannual Report a section on carbon steel container corrosion has been included to complement prior work on TiCode-12 and Type 304 stainless steel. The use of crushed tuff as a packing material is discussed and waste package component interaction test data are included. Licensing data requirements to estimate the degree of compliance with NRC performance objectives are specified. 41 figures, 24 tables.

10078 **(ORNL/TM—9301/P1) Properties of electroslag castings: Part 1.** Sikka, V.K. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004769.

This part of several reports to be published on the properties of electroslag castings of 2 1/4 Cr-1 Mo, 9 Cr-1 Mo, and type 316 stainless steel describes the properties of three electroslag-cast valve bodies of type 316 stainless steel. These castings were electroslag cast at the University of British Columbia in Canada from ORNL-supplied electrodes. The castings have been characterized for surface finish, cracking, solidification structure, chemical analysis, hardness, ferrite distribution, tensile properties, Charpy impact properties, and creep properties. Tensile data on these castings were compared with the American Society of Mechanical Engineers (ASME) code minimum values for sand castings. The creep data were compared with the data on sand castings and the ASME code minimum curve for wrought material. 29 figures, 7 tables.

10079 **(PNL-SA—12344) Corrosion of candidate iron-base waste package structural barrier materials in moist salt environments.** Westerman, R.E.; Pitman, S.G. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 8p. (CONF-841157—31). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004548.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

Mild steels are considered to be strong candidates for waste package structural barrier (e.g., overpack) applications in salt repositories. Corrosion rates of these materials determined in autoclave tests utilizing a simulated intrusion brine based on Permian Basin core samples are low, generally <25 μm (1 mil) per year. When the steels are exposed to moist salts containing simulated inclusion brines, the corrosion rates are found to increase significantly. The magnesium in the inclusion brine component of the environment is believed to be responsible for the increased corrosion rates. 1 reference, 4 figures, 2 tables.

10080 **(RFP—3712) DOR-ER direct oxide reduction electrorefining at Rocky Flats.** Baker, B.C.; Guadagnoli, J.F. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1984]. Contract AC04-76DP03533. 17p. NTIS, PC A02. File Number DE85004974.

Direct oxide reduction (DOR) is a one-step process for converting plutonium dioxide to plutonium metal. Calcium metal, a strong reducing agent, reacts with the plutonium dioxide. The impure plutonium metal is purified by electrorefining (ER).

10081 **(RFP—3748) Evaluation of beryllium surface defects observed following chemical milling.** Ferrera, C.L. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1985]. Contract AC04-76DP03533. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005178.

Surface defects referred to as protrusions and depressions were observed on parts made from commercial quality beryllium after chemical milling. Surface defects referred to as a depression, mottling, and pitting were observed on parts made from 35 ksi yield strength beryllium after chemical milling. This paper summarizes the results of the metallographic and tensile testing performed to characterize the surface defects observed and to determine their effect on the properties of parts.

10082 **(UCRL—91581) Electrochemical cell to measure corrosion rates in noncondensing environments.** Truhan, J.J.; Chen, C.; Kirk, F.C. (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 22p. (CONF-8410198—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003148.

From 12. DOE compatibility meeting; Kansas City, KS, USA (16 Oct 1984).

We have constructedad used an electrochemical cell to estimate corrosion rates in a noncondensing environment, i.e., water-saturated air (100% relative humidity). In this initial effort, we compared the corrosion rates for a variety of metals and alloys in water-saturated air in the electrochemical cell with the corrosion rates of these materials in aerated and deaerated deionized water in an aqueous cell. For most materials, corrosion rates in the humid-air environment were not more than an order of magnitude lower than those in water. Using Faraday's-law calculations, we determined corrosion rates by linear polarization and by Tafel extrapolation. We also measured galvanic potentials and currents between selected dissimilar-metal couples.

10083 **High-resolution, low-temperature, photoemission studies of heavy-fermion systems: UBe_{13} and UPt_3.** Arko, A.J.; Olson, C.G.; Wieliczka, D.M.; Fisk, Z.; Smith, J.L. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **53**: No. 21, 2050-2053(19 Nov 1984). Contract W-7405-ENG-82.

High-resolution (0.13 eV) photoemission measurements performed at low temperatures (roughly-equal20 K) show that a sharp feature (measured width ≅0.15 eV at full width at half maximum) exists at the Fermi edge in the electronic structures of UBe_{13} and UPt_3. In UBe_{13} the feature shows some temperature dependence.

10084 **The effect of different aluminum alloy surface compositions on barrier anodic film formation.** Panitz, J.K.G.; Sharp, D.J. (Sandia National Laboratories, Albuquerque, New Mexico). *Journal of the Electrochemical Society;* **131**: No. 10, 2227-2232(Oct 1984).

The authors have grown barrier anodic coatings on samples of aluminum alloy with different elemental surface compositions. In one series of experiments, they characterized the surface composition present on 6061 aluminum alloy samples after different chemical treatments including a detergent-water and methyl-ethyl ketone solvent clean, a 50% nitric acid-water etch, and a concentrated nitric acid-ammonium bifluoride etch. They anodized samples which were prepared similarly to those analyzed to evaluate the practical effects of the three different surface compositions. The anodization voltage rise time to 950V at constant current was used as a figure of merit. The solvent cleaned and the 50% nitric acid etched samples required, respectively, 113% and 41% more time to

reach 950V than the concentrated nitric acidammonium bifloride etched samples. In a second series of experiments, they alternately anodized groups of either 6061 or 1100 (commercially pure) aluminum alloy, observed rise times to 950V, and measured chloride ion concentrations in the electrolyte. Longer rise times and higher chloride ion concentrations were observed for the 1100 samples. It was observed that the chloride ion concentration fell from initially high levels when 6061 samples were anodized. The results of both series of experiments augment the results of other investigators, who report that the surface species initially present on aluminum have a significant effect on anodic film formation.

10085 **In-Situ laser Raman spectroscopic study of anodic corrosion films on nickel and cobalt.** Melendres, C.A.; Xu, S. (Argonne National Laboratory, Argonne, Illinois). *Journal of the Electrochemical Society;* **131**: No. 10, 2239-2243(Oct 1984).

In-situ laser Raman spectra of anodic corrosion films formed on Ni and Co in 0.05M NaOH have been obtained for the first time and the composition of the surface films deduced. The Raman spectrum of the film found on Ni at about 0.6V vs. Hg/HgO corresponds closely to that of hydrated Ni_2O_3. The anodically formed film on Co at about 0.45 V appeared to consist of a mixture of CoO and Co_3O_4.

10086 **Irradiation effects on high-temperature gas-cooled reactor structural materials.** Lindgren, J.R. (GA Technologies Inc., P.O. Box 85608, San Diego, California). *Nuclear Technology;* **66**: No. 2, 607-618(Sep 1984).

A preliminary study has been completed on how irradiation affects structural materials of high-temperature gas-cooled reactor (HTGR) steam cycle/ cogeneration plant components. A literature search was conducted on irradiation data available for reactor component materials, and results are summarized. Data on materials for the core lateral restraint, core peripheral seal, thermal barriers, and control/power rods are reviewed. Irradiation data on the metals (lowalloy carbon steel, Hastelloy alloy X, alloy 800, and Inconel-718) and on the ceramics (alumina and silica) indicate no major changes on the tensile or creep strengths of the materials occurring at fluences that exceed those found in the HTGR, which are expected to be 1 X 10^{17} n/cm^2 fast and 1 X 10^{17} n/cm^2 thermal. Ductility of most of the metals is significantly reduced and this reduction needs to be considered in design of the components exposed to irradiation. Future work on irradiation effects studies will be focused on the high cycle fatigue behavior of the metals since those data are not yet available. The effects of irradiationinduced creep on the stress relaxation of Inconel-718 core lateral restraint springs also need to be determined.

10087 **Electrotransport and diffusivity of molybdenum, rhenium, tungsten, and zirconium in β-thorium.** Schmidt, F.A.; Beck, M.S.; Carlson, O.N.; Conzemius, R.J.; Rehbein, D.K. (Ames Laboratory, USDOE, Iowa State University, Ames, Iowa). *Journal of the Electrochemical Society;* **131**: No. 9, 2169-2174(Sep 1984).

The electric mobilities, diffusivities, and effective valences were determined for molybdenum, rhenium, tungsten, and zirconium in β-thorium. All four solutes migrated in the same direction as the electron flow. Rhenium and molybdenum were found to be very mobile, with tungsten somewhat slower. Zirconium was found to move at a rate near that of the self-diffusion of β-thorium, viz., about 10^{-11} m^2/s at 1500°C. The electromigration velocities showed a similar trend. A comparison was made between experimental data obtained by scanning laser mass spectrometry and theoretical transport equations for two purification experiments. Good agreement was obtained with both the concentration profile predicted by DeGroot and the purification ratio predicted by Verhoeven.

10088 **Heat effects in Zircaloy oxidation by steam.** Olander, D.R. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory and Department of Nuclear Engineering, University of California, Berkeley, California). *Journal of the Electrochemical Society;* **131**: No. 9, 2161-2169(Sep 1984).

Partitioning of the heat of combustion during Zircaloy oxidation between the gas-oxide and oxide-metal interfaces was determined. The spatial distribution of the heat release is very sensitive to the poorly known partial molar enthalpy of oxygen dissolution in ZrO_2. This uncertainty is of minor consequence in the thermal analysis, however, because temperature gradients in the specimen due to the heat released by oxidation are very small. The temperature is mainly a function only of time. A simple lumped-capacity thermal analysis suffices to describe the temperature transient initiated by the corrosion process. A method of coupling the temperature rise due to the heat release to the corrosion kinetics was developed.

10089 **Diffusivity of hydrogen in nickel at low temperatures.** Lee, K.A.; Mclellan, R.B. (Rice Univ., Houston, TX). *Scripta Metallurgica;* **18**: 859-861(Aug 1984).

Previous experimental results are discussed to determine the mechanisms of hydrogen diffusion in Ni below 1000 K. The studies cover temperatures down to 273 K, and involved desorption and electrochemical techniques. Constant-current and potentiostatic depletion methods were used to measure diffusivity. The data reveal no hydrogen trapping in well-annealed Ni at temperatures as low as 273 K. The evidence therefore supports the concept of thermally activated diffusion. 14 references.

10090 **The effect of quench rate on the microstructure, mechanical properties, and corrosion behavior of U-6 Wt Pct Nb.** Eckelmeyer, K.H.; Romiy, A.D.; Weirick, L.J. (Sandia Nat. Lab.). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **15A**: No. 7, 1319-1330(Jul 1984).

The effect of cooling rate on microstructure, mechanical behavior, corrosion resistance, and subsequent age hardenability is discussed. Cooling rates in excess of 20 Ks^{-1} cause the parent γ-phase to transform martensitically to a niobium supersaturated variant of the α-phase. This phase exhibits low hardness and strength, high ductility, good corrosion resistance, and age hardenability. As cooling rate decreases from 10 Ks^{-1} to 0.2 Ks^{-1}, microstructural changes (consistent with spinodal decomposition) occur to an increasing extent. These changes produce increases in hardness and strength and decreases in ductility, corrosion resistance, and age hardenability. At cooling rates less than 0.2 Ks^{-1} the parent phase undergoes cellular decomposition to a coarse two-phase lamellar microstructure which exhibits intermediate strength and ductility, reduced corrosion resistance, and no age hardenability. An analysis of the cooling rates indicates that fully martensitic microstructures can be obtained in plates as thick as 50 mm.

10091 **Identification of Cu_5Zr phase in Cu-Zr alloys.** Lou, M.Y.W.; Grant, N.J. (The Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **15A**: No. 7, 1491-1493(Jul 1984).

Until recently a number of structure-property relationship studies on Cu-Zr and Cu-Zr-Cr alloys identified Cu_3Zr (32.4 wt pct Zr) as the Zr-containing precipitate phase. Other researchers, using electron microprobe analysis, have identified three possible compositions for the first intermetallic phase in the Cu-Zr phase diagram: Cu_4Zr (26.4 wt pct Zr), Cu_9Zr_2 (24.2 wt pct Zr), and Cu_5Zr (22.3 wt pct Zr). In the present study, electrolytic extractions were used to isolate the Cu-Zr precipitate from the matrices of two Cu-Zr alloys. Alloy 1, Cu-0.18 wt pct Zr, was obtained as hot rolled plate; alloy 2, Cu-0.63 Zr-0.40 Cr-0.59 Al (wt pct) was obtained in cast ingot form and cold rolled 50 pct R.A. to break up the dendritic structure. The alloys were supplied by AMAX. Both alloys were solution and homogenization treated at 950°C for two hours, water quenched, aged at 500°C for eighteen hours, and air cooled. Prior to selective dissolution of the phases, the test specimens were ground and polished with 600 SiC paper. X-ray diffraction was used to identify the electrolytically extracted precipitate phase in a dilute addition of Zr in Cu and a Cu-Zr-Cr-Al alloy of 0.63 wt pct Zr. Cu_5Zr is confirmed to be the first intermetallic phase of the Cu-Zr binary system.

10092 **Segregation and Influence of Boron on the impact toughness of Ti-6 Pct Al-2 Pct Nb-1 Pct Ta0.8 Pct Mo welds and castings.** Inouye, H.; Davis, S.A. (Oak Ridge Nat. Lab., Oak Ridge, TN). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **15A**: No. 7, 1505-1507(Jul 1984).

Trace levels of boron (>0.0010 pct) lowered the impact toughness of welds and castings of Ti-6211. Because the boron effect is also observed in titanium and other titanium alloys, determining the embrittling mechanism is the objective of a continuing study. This study indicates that impaired toughness may result from preferential segregation of boron to the grain boundaries and/or refinement of the $\alpha + \beta$ colony microstructure.

10093 **Laser processing of cast iron for enhanced erosion resistance.** Chen, C.H.; Altstetter, C.J.; Rigsbee, J.M. (Department of Metallurgy and Mining Engineering, University of Illinois at Urbana-Champaign, Urbana, IL). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **15A**: No. 4, 719-728(Apr 1984).

The surfaces of nodular and gray cast iron have been modified by CO_2 laser processing for enhanced hardness and erosion resistance. Control of the near-surface microstructure was achieved primarily by controlling resolidification of the laser melted layer through variations in laser beam/target interaction time and beam power density. Typical interaction times and power densities used were 5 msec and 500 kW/cm^2. Two basic kinds of microstructure can be produced-a feathery microstructure with high hardness (up to 1245 HV) and a dendritic microstructure with a metastable, fully austenitic matrix and lower hardness (600 to 800 HV). Erosion testing was done using slurries of SiO_2 or SiC in water. Weight loss and crater profile measurements were used to evaluate the erosion characteristics of the various microstructures. Both ductile and gray cast iron showed marked improvement in erosion resistance after laser processing.

10094 **The fracture of ordered (Fe, Co)$_3$V.** Liu, C.T.; Schulson, E.M. (Oak Ridge Nat. Lab., Oak Ridge, TN). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **15A**: No. 4, 701-706(Apr 1984).

Observations have been made of fracture surfaces deformed at low strain rates (3.3 and 42 X 10^{-3} S^{-1}) in tension at temperatures from 20 to 1000°C, that is, above and below the order/disorder transformation temperature of 950 + or - 10°C. From 20 to 700°C, transgranular fracture occurs via the nucleation, growth, and coalescence of microvoids; high ductilities are obtained (34 to 44 pct). From 700 to 960°C, the fracture mode changes from transgranular to intergranular and ductility falls to a minimum of 4 pct. At 1000°C a third mode operates consisting of localized dynamic recrystallization followed by boundary sliding of recrystallized grains; ductility rises sharply. The underlying mechanisms are supported through additional experiments performed at higher strain rates.

10095 **Zero-flux planes and flux reversals in the Cu-Ni-Zn system at 775°C.** Kim, C.W.; Dayananda, M.A. (Department of Ordinance Engineering, Korean Military Academy, Seoul). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **15A**: No. 4, 649-660(Apr 1984).

Ternary diffusion was investigated at 775°C for the development of zero-flux planes (ZFP) and flux reversals of the individual components. ZFP's, where the interdiffusion flux of either Cu, Ni, or Zn goes to zero, were identified in single phase and multiphase solid-solid diffusion couples assembled with α (fcc), β (bcc), or γ (cubic) Cu-Ni-Zn alloys and characterized by terminal alloys of similar thermodynamic activity for one of the components. Profiles of interdiffusion fluxes were determined from concentration profiles. The diffusion path for a single phase couple with a ZFP was experimentally found to be invariant with diffusion time. The locations of ZFP's within the diffusion zone of a couple corresponded to sections where the activity of a component was the same as its activity in either of the terminal alloys of the couple. Couples developing ZFP's showed regions where a component diffused up its own activity gradient. The diffusional interactions among the components described by the ratios of cross to main ternary interdiffusion coefficients were determined directly from the slopes of the diffusion paths at various ZFP compositions. In several multiphase couples, discontinuous flux reversals for the components were also identified at the β/α and γ/β interfaces. A discontinuous flux reversal for a component was observed at a planar interface when the activity of the component at the interface corresponded to its activity in one of the terminal alloys of the couple.

10096 **Modeling of fusion activation product release and reactor damage from rapid structural oxidation.** Piet, S.J.; Kazimi, M.S. (EG and G Idaho, Inc./Fusion Safety, P.O. Box 1625, Idaho Falls, ID 83415). *Nuclear Technology/Fusion;* **4**: No. 2, 1115-1120(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Rapid structural oxidation resulting from accidental high temperature exposure of activated fusion material to reactive gases is potentially an important mechanism in the release of radioactivity or damage to the reactor. The reaction rates of 316 SS, HT-9, V-alloy, and TZM with air have been examined on the basis of theory and previous experiments. The low melting points of the primary oxides of the base metals cause oxidation of V-alloy and TZM to become very rapid above approximately 700°C, although vanadium species are far less volatile. The Mo content of 316 SS and HT-9 appears to make them susceptible to rapid oxidation above approximately 1000 and 1300°C, respectively. At such temperatures, the oxidation rates of steels are predicted to be over an order of magnitude less than Mo and V. The volatilization rates of TZM are expected to be several orders of magnitude higher than the other materials studied.

10097 **High temperature oxidation and mobilization of activated structural species.** Henslee, S.P. (EG and G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID 83415). *Nuclear Technology/Fusion;* **4**: No. 2, 1131-1134(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The volatility of a proposed fusion reactor structural alloy, Path-A Prime Candidate Alloy, a modified 316 stainless steel, was investigated. Tests were conducted in nonstatic air at temperatures from 723 to 1473 K (450 to 1200°C) for durations of 1 to 100 n. Results indicate that no significant volatility occurred for any major alloying constituent with the notable exception of molybdenum. The volatility of molybdenum is temperature dependent. An apparent activation energy was determined for the volatility of molybdenum from 1073 to 1473 K.

10098 **Gamma radiation effects on tritium permeation through stainless steel.** Longhurst, G.R.; Deis, G.A. (EG and G Idaho, Inc./Fusion Technology, P.O. Box 1625, Idaho Falls, ID 83415). *Nuclear Technology/Fusion;* **4**: No. 2, 681-686(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Experiments were conducted in the gamma irradiation facility of the Advanced Test Reactor at the Idaho National Engineering Laboratory to determine whether gamma radiation has an appreciable effect on the normal permeation of tritium through stainless steel. Low concentrations of HT were allowed to diffuse through a 0.071-cm-thick tube of 316 stainless steel, heated between 590 and 733 K. Gamma irradiation intensities were varied from 1.3 to 155 C/kgXh (5 X 10^3 to 6 X 10^5 R/h). Ion chamber detectors were used to measure tritium concentrations on both sides of the tube. It was found that in the presence of excess H_2, the higher gamma irradiation intensity exhibited slightly higher permeation rates of tritium. When the walls of the permeation tube and the HT were highly oxidized, the permeation rates were much more scattered, and the gamma irradiation seemed to have no observable effect. It was concluded that the effect of gamma radiation on tritium permeation through stainless steel in a fusion reactor environment should be small. However, the relative ease with which tritium from HTO was seen to permeate the material raises questions regarding tritium management in breeder blankets.

10099 **On isotopic tailoring for fusion reactor radioactivity reduction.** Youssef, U.Z.; Conn, R.W. (Fusion Engineering and Physics Program, School of Engineering and Applied Science, Univ. of California at Los Angeles, CA 90024). *Nuclear Technology/Fusion;* **4**: No. 2, 1177-1182(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Identified are the natural isotopes of five possible structural materials or alloying constituents (Mo, Ni, Cr, Fe, V) which theoretically produce the lowest level of induced radioactivity, biological hazard potential (BHP), and afterheat in a fusion reactor. Activity is examined at shutdown and at very long times after blanket disposal (1000 years). The analyses have been carried out using blankets designed for the WITAMIR-I D-T and the SATYR D-D fueled tandem mirror reactors.

10100 **The influence of steel type on the activation and decay of fusion reactor first walls.** Blink, J.A.; Lasche, G.P. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA 94550). *Nuclear Technology/Fusion;* **4**: No. 2, 1146-1151(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Five steels (PCA, HT-9, thermally stabilized 2.25 Cr-1 Mo, Nb stabilized 2.25 Cr-1 Mo, and 2.25 Cr-1 V) are compared as a function of time from the viewpoints of activation, afterheat, inhalation biological hazard potential (BHP), ingestion BHP, and feasibility of disposal by shallow land burial. An additional case uses the 2.25 Cr-1 V steel with a liquid metal wall (LMW) protective shield between the neutron source and the wall. (This geometry is feasible for inertial confinement fusion reactors.) The PCA steel is the worst choice and the LMW protected 2.25 Cr-1 V is the best choice by substantial margins from all five viewpoints. The HT-9 and two versions of 2.25 Cr-1 Mo are roughly the same at intermediate values. The 2.25 Cr-1 V has about the same afterheat as those three steels, but its waste disposal feasibility is considerably better. Under NRC's proposed low level waste disposal rule (10CFR61), only the 2.25 Cr-1 V could be considered low level waste suitable for shallow land burial.

10101 **A minimum-thickness low-activation toroidal field coil concept for tokamak reactor.** Chen, W.; Cheng, E.T. (GA Technologies Inc., P.O. Box 85608, San Diego, CA 92138). *Nuclear Technology/Fusion;* **4**: No. 2, 1346-1351(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A minimum thickness, low activation toroidal field coil design concept is presented. The concept is consistent with the low activation fusion reactor design requirements suitable for STARFIRE type devices. The design approach consists mainly of replacing the high activation components such as stainless steel structure and copper stabilizer in the high flux region of the TF coils by low activation components such as aluminum alloy structure and aluminum stabilizer, while leaving the core of the coils unchanged from earlier designs. The resulting low activation front regions will reduce the dose level due to its lower residual activity and the fact that it is acting as a shield between the high activity core and the personnel access area. The cross sectional areas required for various low activation TF coil options were compared in order to develop a design that fits within the very constrained space suitable in the inboard region of a tokamak reactor.

10102 **Lifetime analysis of beryllium pebbles in a hybrid fusion blanket.** Miller, L.G.; Buston, J.M. (EG and G Idaho, Inc., Idaho Falls, ID 83415). *Nuclear Technology/Fusion;* **4**: No. 2, 427-432(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The lifetime of hollow beryllium pebbles in a hybrid fusion blanket was estimated using the existing radiation damage data base. The ductility of the irradiated beryllium at 400 to 500°C was estimated as about3%, and the loading stresses produced a strain of <0.3%. The failure analysis was based on the maximum stress theory. The principal stresses calculated were thermal and swelling. The estimated lifetimes for beryllium pebbles were <2 yr for those near the first wall of the blanket, >2 yr for those near the center, and >9 yr for those near the back wall. An overall average lifetime of 2.6 yr was calculated for the hollow beryllium pebbles. The snap-ring fuel form, not considered in this analysis, is expected to give longer beryllium lifetimes, provided stress concentration effects are not present.

10103 **Monte Carlo calculations of neutron and gamma-ray energy spectra for fusion reactor shield design: comparison with experiment.** Santoro, R.T.; Barnes, J.M. (Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* **4**: No. 2, 367-372(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Neutron and gamma-ray energy spectra resulting from the interactions of about14 MeV neutrons in laminated slabs of stainless steel type-304 and borated polyethylene have been calculated using the Monte Carlo code MCNP. The calculated spectra are compared with measured data as a function of slab thickness and material composition and as a function of detector location behind the slabs. Comparisons of the differential energy spectra are made for neutrons with energies above 850 keV and for gamma rays with energies above 750 keV. The measured neutron spectra and those calculated using Monte Carlo methods agree within 5% to 50% depending on the slab thickness and composition and neutron energy. The agreement between the measured and calculated gamma-ray energy spectra are also within this range. The MCNP data are also in favorable agreement with attenuated data calculated previously by discrete ordinates transport methods and the Monte Carlo code SAMCE.

10104 **Identification of zero-flux planes and flux reversals in several studies of ternary diffusion.** Kim, C.W.; Dayananda, M.A. (Korean Military Academy, Seoul). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **14A**: 857-864(May 1983). Contract AC02-81ER10814.

Several past studies of isothermal diffusion in ternary systems have been examined for the identification of zero-flux planes (ZFP) and flux reversals of the individual components. The phenomenon of ZFP initially recognized in the Cu-Ni-Zn diffusion couples has now been identified in several ternary systems including Cu-Ag-Au, Cu-Zn-Sn, Fe-Ni-Co, Fe-Ni-Al, and Co-Ni-Cr. The development of ZFP is dictated by the terminal alloys of the diffusion couples and can occur in both single phase and multiphase assemblies. Discontinuous flux reversals can also occur at interfaces in multiphase systems. The compositions of ZFP's developed for a couple correspond to the intersections of its diffusion path and the isoactivity lines for the components drawn through the terminal alloy compositions on a ternary isotherm.

10105 **Geometric rationale for the hydrides of beryllium-based intermetallic compounds.** Westlake, D.G. (Argonne National Lab., IL). *Materials Research Bulletin;* **18**: 1409-1418(1983).

A geometric model was developed earlier for the prediction of stoichiometries and preferred hydrogen sites in the hydrides of intermetallic compounds whose components are primarily transition metals. For stable hydrides, the geometric criteria are a minimum hole radius of 0.40 A and a minimum hydrogen-hydrogen distance of 2.10 A. The present investigation demonstrates the applicability of this invariant set of criteria to four hydrogenated intermetallic compounds, of three different structures, but all based on beryllium, a Group IIa metal that is known to form a covalent hydride, BeH_2. $ZrBe_2$ and $HfBe_2$ are both hexagonal (C32) and belong to space group P6/mmm, while VBe_2 is hexagonal (C14, space group $P6_3/mmc$), and $TiBe_2$ is cubic (C15, space group Fd3m). Because the 2c hexahedral interstices in $ZrBe_2$ and $HfBe_2$ have radii considerably larger than 0.40 A, the absorption of hydrogen can occur readily by solid solution, and no phase transformation would seem to be required. The predicted occupation of 2c hexahedral interstices in $ZrBe_2H$/sub n/ and $HfBe_2H$/sub n/ is in full agreement with the published experimental determination of site occupation in $ZrBe_2D$/sub 1.5/. The anomalously small volume expansion in the deuteride is discussed in terms of size and shape of the 2c interstice. For

$ZrBe_3D$/sub 2.3/, either there must be a phase transformation, or the 6k tetrahedral interstices, coordinated by two zirconium atoms and two beryllium atoms, must be partially occupied. None of the interstices in either VBe_2 or $TiBe_2$ meets the size criterion, and the resulting prediction of low hydrogen solubility is in accord with published absorption capacities of n - 0.1 and 0.05, respectively.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 3602009431, 9844, 9990, 9996, 10069, 10226

10106 **(IS-M—524) Neutron scattering studies of graphite intercalation compounds.** Kamitakahara, W.A. (Ames Lab., IA (USA)). Oct 1984. Contract W-7405-ENG-82. 4p. (CONF-8410200—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003079.

From Materials Research Society symposium; Cambridge, MA, USA (1 Oct 1984).

The use of neutron scattering to investigate graphite intercalation compounds (GICs) has greatly increased over the past few years. Prior to about 1980, only a single limited study on RbC_6 had been published, but neutron methods are now (1984) among the more common techniques employed on GICs. Neutrons offer a number of advantages in this area. Both structural and dynamical information can be obtained, usually on the same samples in a single experiment. The information is often unique, e.g., as in the case of diffusion studies by quasi-elastic neutron scattering (QENS), and the spectroscopy of q not equal to 0 phonons. Experimental results of neutron scattering studies and lithium-graphite compounds are presented and discussed. (WHK)

10107 **(LBL—18179) Models of creep crack growth in ceramics.** Thouless, M.D. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering). Jul 1984. Contract AC03-76SF00098. 139p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85004088.

Thesis.

A model is developed to describe the velocity of a dominant crack in polycrystalline ceramics at elevated temperatures. The crack propagates by the growth and coalescence of cavities in a damage zone at the crack tip. The growth of the cavities is constrained by the matrix. The resultant crack velocity is proportinal to the applied mode I stress intensity factor (K) and inversely proportional to the viscosity of the material (eta). It has a more complex dependence upon the grain size (l), the cavity spacing (λ), the damage zone size (z) and the critical cavity size for grain facet failures (A/sub f/). The stress in the damage zone is very small but rises to a peak at the periphery. In the regime away from the influence of either the critical stress intensity factor or the threshold, the predicted velocities agree with experiment. The effect of surface tension upon the crack velocity negligible except in the region of the threshold. It is possible that A/sub f/ may be approximated by the condition for the cavity morphology to change from a lenticular to a crack-like shape. This transition occurs at lower values of A/sub f/ as (l/λ) decreases or K increases, consequently there is deviation from linearity with applied stress. At elevated temperatures, a ceramic responds visco-elastically to stress; consequently at high crack velocities, the constraint may be dominated by the elastic characteristics of the matrix. An elastic solution is presented which tends to the unconstrained solution at large stresses. At lower stresses a threshold is predicted, but this is invalid because its existence negates the elastic assumption. In the vicinity of the critical stress intensity factor (K/sub c/), some of the grains fail by cleavage along the grain boundaries rather than by cavity growth. Finally, experimental and theoretical work is presented for crack growth in liquid phase sintered materials.

10108 **(LBL—18411) Densification and deformation in the presence of a liquid phase.** Marion, J.E. II. (Lawrence Berkeley Lab., CA (USA)). Jul 1984. Contract AC03-76SF00098. 241p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85005101.

The mechanisms for creep and sintering of solid materials in the presence of a liquid phase are explored. In Part 1, the sintering behavior of a simple ceramic/glass system is studied. Densification involves concurrent viscous flow and solution/reprecipitation processes for which equations are proposed. Comparison of these equations with microstructural observations suggests that thin equilibrium grain boundary films can support gradients in normal stresses required for diffusive matter transport through the liquid. Evidence is presented for the existence of significant structure within the thin grain boundary films. The final stage in the liquid-phase sintering process, the closure of pores, is modeled using an extreme value distribution to describe the sizes of the shrinking pores. In Part 2, the investigation focuses on high temperature deformation in the presence of a liquid phase. At low stress levels, continuous deformation, without failure, is possible by matter transport through the liquid phase. At higher local stress levels, cavities form within the liquid and permit more rapid deformation leading to eventual failure. TEM results on creep damage in several liquid-phase sintered ceramic alloys exposed to creep strains at elevated temperatures are used to propose a sequence for the early stages of cavitation damage. Interface failure time models are generated for each step. Equations are derived for the growth and coalescence times for oblate holes in thin glass films along two grain interfaces. Times for formation of spherical holes along three grain channel glass pockets and growth to full-facet sized cavities are evaluated.

10109 **(N—84-21347) Microstructure-property relationship for porous CaO stabilized ZrO2 support tubes.** Rossing, B.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Oct 1983. 11p. NTIS, PC A16/MF A01.

In Brookhaven National Lab., proceedings of the conference on high temperature solid oxide electrolytes, Volume 1, 45-55, N—84-21342 11-76.

The active elements of the Westinghouse solid oxide electrolyte fuel cell are supported on porous CaO stabilized ZrO2 tubes. These support tubes must possess adequate mechanical strength to survive both fabrication activities as well as long term cell operation. At the same time, gas diffusion rates through the porous structure must be high enough so as not to limit cell fabrication and cell operation processes that are dependent upon gas transport. Both mechanical properties and gas diffusion rates are strongly related to tube microstructure. These property-microstructure relationships are described. Using this understanding, porous support tubes with improved properties can be realized through compositional developments and/or processing innovations.

10110 **(N—84-21353) Electrochemical applications of stabilized zirconia.** Stern, K.H. (Naval Research Lab., Washington, DC (USA)). Oct 1983. 15p. NTIS, PC A16/MF A01.

In Brookhaven National Lab., proceedings of the conference on high temperature solid oxide electrolytes, Volume 1, 127-139, N—84-21342 11-76.

Various uses made of stabilized zirconia (SZ) are described. They can be placed in two categories: those in which virtually no charge is passed (equilibrium applications), and dynamic applications in which substantial amounts of charge are passed through the SZ. First the interfacial processes occurring in both applications are described.

10111 **(N—84-21360) Preparation and properties of electrically conducting ceramics based on indium oxide-rare Earth oxides-hafnium oxide.** Marchant, D.D.; Bates, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1983. 10p. NTIS, PC A16/MF A01.

In Brookhaven National Lab., proceedings of the conference on high temperature solid oxide electrolytes, Volume 1, 259-267, N—84-21342 11-76.

Electrically conducting refractory oxides based on adding indium oxide to rare earth-stabilized hafnium oxide are being studied. The use of indium oxide generally increases the electrical conductivity. The results of measurements of the electrical conductivity and data on corrosion resistance in molten salts are presented.

10112 **(N—84-21369) Re-examination of beta-alumina doped with chromium using photoacoustic spectroscopy.** Schuler, A.M.; Kennedy, J.H. (Brookhaven National Lab., Upton, NY (USA)). Oct 1983. 12p. NTIS, PC A07/MF A01.

In Brookhaven National Lab., proceedings of the conference on high temperature solid oxide electrolytes, Volume 2, 1-12, N—84-21368 11-76.

A previous publication presented evidence that strongly supported the hypothesis that chromium-doped beta alumina was oxidized to Cr (IV) during air-sintering. This evidence included chemical reactions observed, magnetic susceptibility, and conductivity, but, in particular, the strongest supporting evidence came from absorption spectroscopy. However, the technique used, powder dispersed in a KBr pellet, was not conductive to high quality spectra. For this reason, a much more powerful technique for solid samples, photo-acoustic spectroscopy, was applied to chromium-doped beta alumina. Additional absorption peaks were observed that now clearly show that chromium remains as Cr (III) in beta alumina. The other previous evidence was reexamined and it too is interpreted as resulting from the presence of chromium (III).

10113 **(N—84-21377) Preparation of sodium beta-alumina by the isostatic pressing and zone sintering of spray dried powders.** Tan, S.R. (Chloride Silent Power Ltd., Runcorn (UK)). Oct 1983. 18p. NTIS, PC A07/MF A01.

In Brookhaven National Lab., proceedings of the conference on high temperature solid oxide electrolytes, Volume 2, 107-124, N—84-21368 11-76.

The preparation of beta-alumina tubes by a route comprising a slurry solution spray drying, iosostatic pressing and zone sintering is reported. Sources of powder heterogeneity are discussed as is the conversion of precursor materials to beta-alumina during firing. Data demonstrating the effectiveness of post-sinter heat treatment for beta-alumina are presented.

10114 **(N—84-21378) Synthesis of Co2+ and Ni2+ stabilized beta alumina.** Chen, S.; White, D.R.; Sato, H.; Sandberg, C.J.; Harrison, H.R. (Purdue Univ., Lafayette, IN (USA)). Oct 1983. 10p. NTIS, PC A07/MF A01.

In Brookhaven National Lab., proceedings of the conference on high temperature solid oxides electrolytes, Volume 2, 125-134, N—84-21368 11-76.

By using a skull melting technique, both single crystalline Ni(2+) and Co(2+) stabilized beta double prime-aluminas and doped beta-aluminas have been synthesized. Both Ni(2+) and Co(2+) beta-aluminas are blue in color, although the Co(2+) material has a deeper hue. Analysis of their visible absorption spectra indicated that the divalent transition metal ions are situated in tetrahedral sites of the spinel blocks.

10115 **(N—84-21740) Overview of zirconia with respect to gas turbine applications.** Cawley, J.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Mar 1984. 29p. (NASA-TP—2286; E—1726). NTIS, PC A03/MF A01.

Phase relationships and the mechanical properties of zirconia are examined as well as the thermal conductivity, deformation, diffusion, and chemical reactivity of this refractory material. Observations from the literature particular to plasma-sprayed material and implications for gas turbine engine applications are discussed. The literature review indicates that Mg-PSZ (partially stabilized zirconia) and Ca-PSZ are unsuitable for advanced gas turbine applications a thorough characterization of the microstructure of plasma-sprayed zirconia is needed. Transformation-toughened zirconia may be suitable for use in monolithic components.

10116 **(N—84-26427) Optical absorption and thermoluminescence in MgO:Ni and MgO:Li irradiated at room temperature.** Delgardo, L. (Junta de Energia Nuclear, Madrid (Spain)). 1984. 37p. (JEN—556). NTIS, PC A03/MF A01.

Optical absorption and thermoluminescence (TL) studies in MgO, MgO:N and MgO:Li irradiated at room temperature are presented. In pure MgO the thermal annihilation of Fe(3+) by recombination with thermally released electrons at approximately 90 and 175 C and the V center annealing by hole release up to 100 C cause the observed glow peaks of these temperatures. The TL excitation spectrum shows two maxima at 245 nm (electron center) and 288 nm (Fe(3+)). In MgO:Ni X irradiation introduces Fe(2+) yields Fe(3+) and Ni(2+) yields Ni(3+) oxidations. Two TL emission bands centered at 100 c (red) and 80 c (green) are assigned to electron release and their recombination at Fe(3+) and Ni(3+) respectively. No V center formation was detected in Ni and Li doped samples.

10117 **(ORNL—6072) Thermodynamics of copper-nickel alloys containing aluminum, silicon, titanium, and chromium relative to their use in ceramic brazing.** Williams, R.O. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004787.

By varying the copper-to-nickel ratio the activity coefficients of Al, Si, Ti, and Cr can be varied over a wide range. Thus to a degree one can tailor the behavior of such alloys for usefulness in brazing ceramics. Further, considerable amounts of these active elements can be present while the ability of carbon to reduce the surface oxide film in a high-vacuum system is retained. The critical aluminum concentrations required to prevent the formation of SiO_2, TiO, or Cr_2O_3 by reaction with Al_2O_3 are calculated. The simultaneous presence of the four active additions will presumably promote wetting without making the surface deoxidation more difficult.

10118 **(ORNL/TM—9466) Ceramic technology for advanced heat engines project. Semiannual progress report, October 1983-March 1984.** Johnson, D.R. (comp.). (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004944.

Significant accomplishments in fabricating ceramic components for the Department of Energy (DOE), National Aeronautics and Space Administration (NASA), and the Department of Defense (DOD) advanced heat engine programs have provided evidence that the operation of ceramic parts in high-temperature engine environments is feasible. However, these programs have also demonstrated that additional research is needed in materials and processing development, design methodology, and data base and life prediction. An assessment of needs was completed and a five-year project plan was developed. The project approach includes determining the mechanisms controlling reliability, improving processes for fabricating existing ceramics, development of new materials with increased reliability, and testing these materials in simulated engine environments to confirm reliability. Focus is on structural ceramics for advanced gas turbine and diesel engines, ceramic bearings and attachments, and ceramic coatings for thermal barrier and wear applications in these engines. To facilitate the rapid transfer of this technology to US industry, the major portion of the work is being done in the ceramic industry. A joint DOE and NASA technical plan has been established with DOE focus on automotive applications and NASA focus on aerospace applications.

10119 **Single crystal structure determination of ReO_3 at 15 kbar.** Alkire, R.W.; Larson, A.C.; Vergamini, P.J. (Los Alamos National Lab., NM (USA)); Schirber, J.; Morosin, B. (Sandia National Labs., Albuquerque, NM (USA)). *Acta Crystallographica, Section A: Crystal Physics, Diffraction, Theoretical and General Crystallography;* 40: C-375/C-376(1 Aug 1984). (CONF-8408130—).

From 13. international congress of the International Union of Crystallography; Hamburg, F.R. Germany (9 Aug 1984).

10120 **Improvements in mechanical properties in SiC by the addition of TiC particles.** Wei, G.C.; Becher, P.F. (Oak Ridge National Laboratory, Oak Ridge, Tennessee). *Journal of the American Ceramic Society;* 67: No. 8, 571-574(Aug 1984).

Silicon carbide ceramics containing up to 24.6 vol% dispersed TiC particles yielded fully dense composites by hot-pressing at 2000°C with 1 wt% Al and 1 wt% C added. The microstructure consists of fine TiC particles in a fine-grained SiC matrix. Addition of TiC particles increases the critical fracture toughness of SiC (to

≈6 MPa /SUP ./ m /SUP 1/2/ at 24.6 vol% TiC) and yields high flexure strength (≅ 680 MPa), with both properties increasing with increasing volume fraction of TiC. The strengths at high temperatures are also improved by the TiC additions. Observations of the fracture path indicate that the improved toughness and strength are a result of crack deflection by the TiC particles.

10121 **(ORNL-tr—5166) Preparation of a rhombohedral boron carbide of the composition $B_{13}C_2$.** Ploog, K. Translated from *Journal of the Less-Common Metals ;* **31**: 177-180(1973). Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003529. DE85003529

NMR and phase studies have led to the conclusion that the central atom of the C_3 chain in rhombohedral boron carbide, must actually be a boron atom. An attempt was therefore made to prepare pure boron carbide crystals of the analytic composition $B_{13}C_2$. A rhombohedral boron carbide having a carbon content of 15.1 to 15.4 wt % ($B_{13}C$/sub 2.08-2.13/) was obtained. The primitive rhombohedral elemental cell of $B_{13}C_2$ (with B_{12} icosahedrons at each vertex) is not a C_3 chain but a linear CBC chain in the [111] direction. It is probable that B_4C is a solid solution of carbon in $B_{12}CBC(B_{13}C_2)$.

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 3604009525, 10103

10122 **(BNL—35534) HREELS and Auger studies of conducting polymers.** Jennings, W.D.; Chottiner, G.S.; Natarajan, C.; Melo, A.V.; Hoffman, R.W.; O'Grady, W.E.; Lundstrom, I.; Salaneck, W.R. (Brookhaven National Lab., Upton, NY (USA); Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Physics; Linkoeping Univ. (Sweden). Dept. of Physics and Measurement Technology). Aug 1984. Contract AC02-76CH00016. 30p. (CONF-8406187—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004541.

From 6. symposium on applied surface analysis; Dayton, OH, USA (6 Jun 1984).

High Resolution Electron Energy Loss Spectroscopy (HREELS) and Auger Spectroscopy have been used to examine the surface of conducting polymer samples. The samples were 100 nm thick films of polypyrrole doped with either BF_4 or ClO_4 negative ions. The films were made in Sweden and shipped to the USA for study. HREELS spectra could be obtained without difficulty in the samples' as is condition. These spectra showed broad bands corresponding to known polypyrrole vibrational modes. Exposure of the polymer to oxygen had no effect, but water could be adsorbed on the samples at 130 K. In addition to vibrational excitations, broader electronic transitions were also identified. Auger studies were performed in an effort to characterize the surface. These studies indicate that considerable non-stoichiometry exists in the surface region. There were, as expected, problems due to questionable sample cleanliness, sample charging, and electron beam damage. 21 references, 6 figures, 3 tables.

10123 **(NUREG/CR—3898) Evaluation of the effects of gamma irradiation on the mechanical properties of high density polyethylene.** Dougherty, D.R.; Adams, J.W.; Barletta, R.E. (Brookhaven National Lab., Upton, NY (USA)). Dec 1984. Contract AC02-76CH00016. 100p. (BNL-NUREG—51802). NTIS, PC A05/MF A01 - GPO $4.75. File Number TI85005001.

Mechanical tests following gamma irradiation and creep tests during irradiation have been conducted on high-density polyethylene (HDPE) to assess the adequacy of this material for use in high-integrity containers (HICs). These tests were motivated by experience in nuclear power plants in which polyethylene electrical insulation deteriorated more rapidly than expected due to radiation-induced oxidation. This suggested that HDPE HICs used for radwaste disposal might degrade more rapidly than would be expected in the absence of the radiation field. Two types of HDPE, a highly cross-linked rotationally-molded material and a non-cross-linked blow molded material, were used in these tests. Gamma-ray irradiations were performed at several dose rates in environments of air, Barnwell and Hanford backfill soils, and ion-exchange resins. The results of tensile and bend testing on these materials following irradiation at 10 to 11°C showed no effects directly or solely attributable to radiation-induced oxidation. However, effects due to radiation-induced cross-linking, including an increase in yield strength and decreases in both elongation at yield and elongation at break, were observed. Irradiation at 60 to 63°C showed effects or radiation-induced oxidation including a decrease in yield strength. These effects were more marked in thinner test specimens. Creep testing during irradiation indicated that irradiation increases the creep rate but that the effect is really only significant at creep loads greater than about half the nominal yield strength under the conditions of these tests (10 to 11°C and 5 krad/h). 29 references, 52 figures, 9 tables.

10124 **(SAND—84-1759C) Effect of alternative aging and accident simulations on polymer properties.** Bustard, L.D.; Chenion, J.; Carlin, F.; Alba, C.; Gaussens, G.; LeMeur, M. (Sandia National Labs., Albuquerque, NM (USA); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1984. Contract AC04-76DP00789. 26p. (CONF-8410142—35). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85002642.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The response of eighteen US and French polymer materials to variations in aging and accident simulation techniques has been determined by this experimental program. This information will provide a partial data base by which to judge appropriate simulation practices. The overall research goal was to determine whether some aging and accident simulation techniques are better suited for qualification activities than other alternative simulation techniques.

10125 **Optimization of permanganic etching of polyethylenes for scanning electron microscopy.** Naylor, K.L.; Phillips, P.J. (Univ. of Utah, Salt Lake City). *Journal of Polymer Science, Polymer Physics Edition;* **21**: 2011-2026(1983). Contract AC02-79ER10421.

The permanganic etching technique has been studied as a function of time, temperature, and concentration for a series of polyethylenes. Kinetic studies show that a film of reaction products builds up on the surface, impeding further etching, an effect which is greatest for the lowest-crystallinity polymers. SEM studies combined with EDS show that the film contains sulfur, potassium and some manganese. An artifact is produced by the etching process which is impossible to remove by washing procedures if certain limits of time, temperature, and concentration are exceeded. For lower-crystallinity polyethylenes multiple etching and washing steps were required for optimal resolution. Plastic deformation during specimen preparation, whether from scratches or freeze fracturing, enhances artifact formation. When appropriate procedures are used, virtually artifact-free surfaces can be produced allowing a combination of permanganic etching and scanning electron microscopy to give a rapid method for detailed morphological characterization of bulk specimens.

10126 **Dielectric loss behavior of cross-linked polyethylene and analog materials.** Jang, Y.T.; Phillips, P.J. (Univ. of Utah, Salt Lake City). *Journal of Applied Polymer Science;* **28**: 1137-1146(1983). Contract AC02-79ER10421.

The dielectric loss behavior of crosslinked polyethylene has been determined over the frequency range 10-5 khz and over the temperature range -150 to 100°C. Major loss effects occur at the lower temperatures and are caused by liberation of the organic byproducts of the crosslinking agent, dicumyl peroxide. Analog materials prepared from linear low density polyethylene by blending in of either acetophenone or 2-phenyl-2-propanol confirm the hypothesis. The effects of concentration of byproducts and of orientation of the polymer have been studied. Activation energy analyses suggest that room temperature losses will occur in the microwave region. The behavior is significantly affected by curing with steam, typical loss peaks being an order of magnitude lower than for dry cured specimens. A new loss region appears close to but below, 0°C.

3606 Other Materials

REFER ALSO TO CITATION(S) 3606009603, 9603, 9610, 9613, 9623, 9770, 10313, 10605, 10732

10127 (AD—801306/2) Thermal radiation effects on paints, plastics, and coated fabrics. Report for October-November 1951. Miller, H. (Army Engineer Research and Development Labs., Fort Belvoir, VA (USA)). Jul 1952. 104p. NTIS, PC A06/MF A01.

Report on Operation Buster, Project 2.4b.

The object of this project was to determine the effect of thermal flux and other atomic blast phenomena on the service life and use characteristics of selected paint systems, plastics and coated fabrics currently used or proposed for use by the Corps of Engineers. Little or no work has been done previously on evaluating the effect of atom weapon phenomina on these properties. Selected materials were exposed to a laboratory source of thermal flux using Navy searchlight method, with the object of establishing a correlation between laboratory and field test results. Representative paint systems, plastics and coated fabrics were exposed to BAKER and DOG shots at thermal energies ranging from 1.6 cal./sq cm to 85 cal./sq cm. The samples were given a visual inspection in the field and returned to ERDL for laboratory comparison with samples retained at ERDL, to determine the effect of the exposures on the physical properties of the materials.

10128 (BNL—35425) Neutron diffraction study of $(TMTSF)_2BF_4$ after slow and rapid cooling to 20 K. Emge, T.J.; Williams, J.M.; Leung, P.C.W.; Schultz, A.J.; Beno, M.A.; Wang, H.H. (Argonne National Lab., IL (USA); Brookhaven National Lab., Upton, NY (USA)). 1984. Contract W-31-109-ENG-38;AC02-76CH00016. 5p. (CONF-8408137—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003624.

From Molecular crystals and liquid crystal meeting; Abano, Terme, Italy (1 Aug 1984).

The structure of (TMTSF)2BF_4 at 20 K has been determined from neutron diffraction data. It is completely ordered after both fast (6.0 deg. min $^{-1}$) and slow (0.1 deg. min $^{-1}$) cooling through the metal-insulator (MI) transition at 40 K. Significant interactions in the 20 K dimerized phase include both short cation-cation (Se...Se) and cation-anion (Se...F and $^{-}CH_3$...F) contracts.

10129 (BNL—35480) Coexistence of antiferromagnetism and spin-glass ordering in the Ising system $Fe_{0.55}Mg_{0.45}Cl_2$. Wong, P.; Yoshizawa, H.; Shapiro, S.M. (Schlumberger-Doll Research Center, Ridgefield, CT (USA); Tokyo Univ. (Japan). Inst. for Solid State Physics; Brookhaven National Lab., Upton, NY (USA)). Oct 1984. Contract AC02-76CH00016. 16p. (CONF-841184—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004164.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

Fe/sub 1-x/Mg/sub x/Cl_2 is a diluted Ising antiferromagnet with competing first and second neighbor exchange interactions. A previous magnetization study by Bertrand et al has found that at x $\approx$ 0.45, the system undergoes a Neel transition at T/sub N/ $\approx$ 7.4K which is followed by a spin-glass transition at T/sub sg/ $\approx$ 3.0K. We report a quasielastic neutron scattering study on a single crystal sample with this composition. We find that the antiferromagnetic Bragg peak persists down to 1.2K, well below T/sub sg/, and the diffuse scattering becomes temperature independent below about 6.0K, with the correlation length frozen at about 2.3 lattice spacings. No scattering related to the transverse spin-component are observed. These results suggests that there is coexistence between long range antiferromagnetic order and short-range spin-glass order for the longitudinal spin-component. Such a behavior is consistent with the predictions of the vector mean-field theory (infinite range model) for spin-glasses with strong unaxial anisotropy.

10130 (BNL—35505) Neutron spin echo study of the reentrant spin glass Eu/sub x/Sr/sub 1-x/S. Shapiro, S.M.; Maletta, H.; Mezei, F. (Brookhaven National Lab., Upton, NY (USA); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). 1984. Contract AC02-76CH00016. 13p. (CONF-841184—29). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004697.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

Neutron spin echo (NSE) experiments were performed on polycrystalline samples of Eu/sub x/Sr/sub 1-x/S for x = 0.4 and 0.54 in the temperature range of 1.2 < T < 10K and for 0.036 < Q < .18 A^{-1}. The x = 0.4 sample exhibits a paramagnetic (PM) to spin glass (SG) transition near T/sub f/ $\sim$ 2K. In the x = 0.54 sample, large ferromagnetic correlations develop below 5K and a spin-glass state appears at lower temperatures. In the NSE experiment, the spin-spin correlation function, S(Q,t), is measured directly for times between .03 < t < 5 ns. At low temperatures both materials exhibit a weak Q dependence in the dynamics and the spins are essentially frozen over the time range explored. On heating the x = 0.4 sample the spins start to fluctuate more rapidly, but no dramatic change occurs around T/sub f/. On heating the x = 0.54 sample, S (Q,t) decreases rapidly with time. Near the 5K, S(Q,t) is exponential (e/sup -Γ t/) with Γ being strongly Q dependent. Measurements of the depolarization of the scattered beam confirms the absence of true long range ferromagnetic order below T/sub c/

10131 (BNL—35559) Plasma deposition of wide gap, highly photoconductive a-Si:H thin films from disilane-helium mixtures. Rajeswaran, G.; Vanier, P.E.; Corderman, R.R.; Kampas, F.J. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 9p. (CONF-841157—35). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004058.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

Wide gap (>1.9 eV), photoconductive, intrinsic amorphous silicon films were made in a uhv system from Si_2H_6-He mixtures. The hydrogen concentrations, optical gaps and photoconductivities were measured. Unlike films made from SiH_4, Si_2H_6-produced films exhibit excellent electronic properties even at low deposition temperatures. The ratio of AM1 photoconductivity to dark conductivity was as high as 10^7.

10132 (CONF-831187—20) Pressure induced superconductivity in Eu(Ho)Mo_6S_8. Capone, D.W. II; Lai Fook, M.S.; Guertin, R.P.; Foner, S.; Hinks, D.G. (Tufts Univ., Medford, MA (USA); Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.; Argonne National Lab., IL (USA)). Nov 1983. Contract W-31-109-ENG-38. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005033.

From 29. annual conference on magnetics and magnetic materials; Pittsburgh, PA, USA (8 Nov 1983).

The Chevrel phases $EuMo_6S_8$ and Eu-rich Eu/sub 1-x/Ho/sub x/Mo_6S_8 (x = 0.1 and x = 0.2) are not superconducting at ambient pressure, but they become superconducting above 12 kbar, 7 kbar, and 5 kbar, respectively. The T/sub c/ maxima of Ho-doped pseudoternaries are below that of the undoped system (12 K), due to the smaller ionic radius of Ho^{3+} and to the pairbreaking of the large (10 μ/sub B/) Ho ion moment. The superconducting-normal phase boundaries up to 20 kbar for several Eu(Ho)Mo_6S_8 samples are compared to those of $EuMo_6S_8$ and a La-doped sample. An $Eu_{0.6}Ho_{0.4}Mo_6S_8$ sample showed superconductivity at about 3°K and showed a weak maximum in T/sub c/ vs P, indicating a critical concentration of Eu (>0.7) is needed to bring about pressure induced superconductivity in $EuMo_6S_8$-based systems. The high field moment of Ho-doped $EuMo_6S_8$ at 9 T is above that of fully saturated Eu^{2+} ions, but below that of the saturated (Eu^{2+} + Ho^{3+}) ions together, because of crystalline electric field effects on the Ho ions. Results of this work are compared with pure $EuMo_6S_8$ and with $EuMo_6S_8$ samples having controlled oxygen content, and the data are contrasted with data for Eu(La)Mo_6S_8.

10133 (CONF-841157—45) Time-resolved ellipsometry and reflectivity measurements of the optical properties of silicon during pulsed excimer laser irradiation. Jellison, G.E. Jr.; Lowndes, D.H. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005091.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

Several advances in time-resolved optical measurement techniques have been made, which allow a more detailed determination of the optical properties of silicon immediately before, during, and after pulsed laser irradiation. It is now possible to follow in detail the time-resolved reflectivity signal near the melting threshold; measurements indicate that melting occurs in a spatially inhomogeneous way. The use of time-resolved ellipsometry allowed us to accurately measure the optical properties of the high reflectivity (molten) phase, and of the hot, solid silicon before and after the laser pulse. We obtain n = 3.8, k = 5.2 (+-0.1) at λ = 632.8 nm for the high reflectivity phase, in minor disagreement with the published values of Shvarev, et al. for liquid silicon. Before and after the high reflectivity phase, the time-resolved ellipsometry measurements are entirely consistent with the known optical properties of crystalline silicon at temperatures up to its melting point.

10134 (CONF-8410173—3) Some properties of U-Si alloys in the composition range U_3Si to U_3Si_2. Domadgala, R.F.; Wiencek, T.C.; Thresh, H.R. (Argonne National Lab., IL (USA)). Sep 1984. Contract W-31-109-ENG-38. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004075.

From International meeting on reduced enrichment for research and test reactors; Argonne, IL, USA (14 Oct 1984).

U_3Si (3.9 wt % Si) and U_3Si_2 (7.3 wt % Si) have emerged as compounds which may satisfy the goals of the Reduced Enrichment Research and Test Reactor (RERTR) program. In the course of generating powders of these materials and the fabrication of miniplates containing them for irradiation, a number of peripheral studies were conducted. This paper presents information on the hardness, density, microstructural appearance, and, to a limited extent, compatibility with air of alloys in the composition range from 4.0 to 7.5 wt % Si.

10135 (DOE/ER/45051—T1) Crack tip deformation in LiF for Mode I and II cracks on (100) and (110) planes. Appendix A. Chia, K.Y.; Burns, S.J. (Rochester Univ., NY (USA). Dept. of Mechanical Engineering). 1984. Contract FG02-84ER45051. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003912.

In this report, the (100) cleavage plane crack-tip dislocations are reviewed and (110) indentation crack tip dislocations are studied in depth. After (110) indentation cracks were formed in the cube surface, the specimen was subject to either additional indentation loads so that the specimen fractured, or tensile tests to study the mode II crack behavior of the (110) cracks. The specimen invariably broke along one of its (100) cleavage planes, yet never along its original (110) cracked surface. Crack tip dislocations play an important role in shielding the (110) crack tips from subsequent propagation. Unloading effects on crack tip deformations for both (100) plane cleavage cracks and (110) plane indentation cracks have been investigated. Results show that unloading contributes to crack closure deformation in the crack tip region.

10136 (DOE/ER/45077—1) Spectroscopic investigations of glass structure. Progress report, April 1-November 30, 1984. White, W.B.; Minser, D.G.; Knight, D.S.; Merzbacher, C.I.; Plesko, E.P.; Walden, B.L. (Pennsylvania State Univ., University Park (USA). Materials Research Lab.). 15 Dec 1984. Contract FG02-84ER45077. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004715.

This is an investigation of overall structure of insulator glasses and local structural environment of transition metal ions utilizing Raman, infrared, optical absorption and luminescence spectroscopy. Thrusts are local environment of alkali ions in silicate glasses by far infrared spectroscopy; processes of phase separation as related to heat treatment by high temperature Raman spectroscopy; relation of Raman spectra with thermodynamic quantities in silicate glasses; transition metal complex formation; and clustering and nucleation of transition metals from high magnesium glasses.

10137 (LBL—17904) Induced superconducting state in semiconductors and semimetals. Kresin, V.Z. (Lawrence Berkeley Lab., CA (USA)). 1984. Contract AC03-76SF00098. 7p. (CONF-840879—11). NTIS, PC A02. File Number DE85004903.

From 17. international conference on the physics of semiconductors; San Francisco, CA, USA (6 Aug 1984).

Superconductivity in semiconductors is caused by intervalley interaction. Moreover, intervalley interaction may result in the appearance of a non-phonon mechanism. This paper is concerned with a different type of superconductivity in semiconductors (SC) or semimetals (SM), namely, with induced superconductivity. If a SC or SM film is placed on a usual superconductor, there results a superconducting state of SC or SM because of the proximity effect. This proximity system is characterized by interesting features connected with the properties of SC and SM. We focus here on the analysis of the critical temperature T/sub c/, magnetic screening and the Josephson effect.

10138 (LBL—18412) Effect of heating rate and annealing temperature on twin formation in As^+ implanted (111) silicon. Shih, Y.C.; Washburn, J.; Shatas, S.C. (Lawrence Berkeley Lab., CA (USA); AG Associates, Palo Alto, CA (USA)). Jan 1984. Contract AC03-76SF00098. 9p. (CONF-840139—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004894.

From SPIE technical symposium and instrument exhibit; Los Angeles, CA, USA (22 Jan 1984).

The major secondary defect in post-annealed 5 x 10^{14}/cm^2 As^+ implanted (111) silicon is microtwins. This was shown to be true for rapid thermal annealing similar to conventional furnace annealing. However, the twin density after rapid thermal annealing to 1100°C for 10 seconds was found to be greater than that in a comparable specimen furnace annealed at 1000°C for 10 minutes. Sheet resistivity after annealing was found to be closely related to the twin density of the specimen. Thermal stress was shown not to be the cause of this increase in twin growth. The higher average crystal regrowth temperature appears to be responsible for growth of more large area twin. Twins of small size were shown to anneal out at high temperature but large area twins did not. Twin free specimens were obtained by regrowth of the amorphous layer at low temperature which formed only small area twins followed by a high temperature anneal which annihilated all the small twins.

10139 (N—84-20697) Shearing stability of lubricants. Shiba, Y.; Gijyutsu, G. (National Aeronautics and Space Administration, Washington, DC (USA)). Mar 1984. 22p. (NASA-TM—77435). NTIS, PC A02/MF A01.

Shearing stabilities of lubricating oils containing a high mol. wt. polymer as a viscosity index improver were studied by use of ultrasound. The oils were degraded by cavitation and the degradation generally followed first order kinetics with the rate of degradation increasing with the intensity of the ultrasonic irradiation and the cumulative energy applied. The shear stability was mainly affected by the mol. wt. of the polymer additive and could be determined in a short time by mechanical shearing with ultrasound.

10140 (N—84-20716) Behavior of a slag base pavement structure at P39/1, Erasmia under heavy vehicle simulator loading. Horak, E.; Maree, J.H. (National Inst. for Transport and Road Research, Pretoria (South Africa)). Feb 1982. 55p. (RP—5/82). NTIS, PC A04/MF A01.

An evaluation of unbound slag as a basecourse material using the Heavy Vehicle Simulator (HVS) was undertaken. Two HVS tests were performed on site P39/1 and with these tests it is possible not only to evaluate slag as a basecourse material, but also to compare it with a good quality crushed-stone base. It was felt that these tests would give further information on the possible use of slag as a basecourse material in Category A roads. A description of the HVS tests on this slag base pavement is given. The test results were evaluated using mechanistic analysis techniques. The behavior of the pavement structure is described and analyzed, and dry

conditions are compared with wet conditions. Finally, general recommendations are made on the use of high standard slag bases.

10141 **(N—84-21751) Thermal diffusion in glass melts. Final Report, September 1982.** Moser, R.; Schaeffer, H.A.; Tomandl, G. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.)). Dec 1983. 63p. (BMFT-FB-W—83-033). NTIS, PC A04/MF A01.

Thermal diffusion with heavy ions in glasses at temperatures transformation (Tg) point is studied. A disk-like sample of glass was heated from above and cooled from below. Mixed alkali glasses containing Rd cations and Cs cations were used. Concentration profiles were measured by energy dispersive analysis with X-rays (EDAX) using scanner electron microscopy, by microprobes, and for radioactive marked samples by autoradiography. These instationary profiles were computed theoretically. Linear temperature profiles show the best accordance with the measured ones. The heavier ion always moves to the cold end. This is also found in glasses containing two alkali metals with different concentration ratios. The differences of the heat of transport is between 2 and 14 KJ/mole. Disturbances by convection are not found. Thermal diffusion should not be a factor in the final storage of radioactive fission products in glass blocks, due to the long time for reaching the steady state. (ESA)

10142 **(N—84-24686) Study of factors determining the radiation sensitivity of quartz crystal oscillators (A0189).** Venables, J.D.; Ahearn, J.S. (Martin Marietta Labs., Baltimore, MD (USA)). Feb 1984. 3p. NTIS, PC A09/MF A01.

In NASA. Langley Research Center, long duration exposure facility (LDEF), 173-175, N—84-24632 15-15.

The correlation between defect cluster concentrations observed for different grades of quartz examined by transmission electron microscopy (TEM) and the electrical stability of quartz resonators exposed to complex radiation in an orbital LDEF was determined. It is demonstrated that the technique TEM provides a powerful method for studying the effect of radiation on crystalline quartz. Two factors suggest that the observed clusters may be responsible for the radiation-induced frequency drift and acoustic absorption effects associated with irradiated quartz resonators: (1) the clusters are expected to be very effective in modifying the piezoelectric properties of quartz because of the large strain fields associated with them; (2) both phenomena appear to be sensitive to the impurity concentration. It is suggested that TEM can be used to classify grades of quartz according to their suitability for use in radiation-hard resonators. This technique may identify the impurities that are responsible and thereby effect an improvement in the stability of quartz oscillators.

10143 **(RFP—3573) Characterization of natural chabazite and 5A synthetic zeolites. Part II. Adsorption properties and porosity.** Stakebake, J.L.; Fritz, J. (Rockwell International Corp., Golden, CO (USA). Energy Systems Group). 1983. Contract AC04-76DP03533. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003964.

Nitrogen adsorption isotherms were measured for four samples of chabazite, which were collected from different geographical locations, and for a Linde 5A synthetic zeolite. All isotherms were Type I and obeyed the Langmuir adsorption model. Surface areas and pore diameters were calculated from the adsorption data. The MP method was used to determine the pore volume distribution for each sample. The results indicated that all of the chabazite samples had nearly identical properties, and these properties were also very similar to those of the Linde 5A synthetic zeolite.

10144 **(SAND—84-0478C) Ion implantation disorder in strained-layer superlattices.** Arnold, G.W.; Picraux, S.T.; Peercy, P.S.; Myers, D.R.; Biefeld, R.M.; Dawson, L.R. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 12p. (CONF-841157—38). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004466.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

Cantilever-beam bending and RBS channeling measurements have been used to examine implantation-induced disorder and stress buildup in $In_{0.2}Ga_{0.8}As/GaAs$ SLS structures. Implantation fluences from 10^{11} to $10^{15}/cm^2$ were used for 150-keV Si, 320-keV Kr, and 250-keV Zn in SLS and GaAs bulk materials. The critical fluence for saturation of compressive stress occurs prior to amorphous layer formation and is followed by stress relief. For all the ions the maximum ion-induced stress scales with energy density into atomic processes and stress relief occurs above $\sim 1 \times 10^{20}$ keV/cm^3. Stress relief is more pronounced for the SLSs than for bulk GaAs. We suggest that stress-relief may lead to slip or other forms of inelastic material flow in SLSs, which would be undesirable for active regions in device applications. Such material flow may be avoided by limiting maximum fluences or by multiple step or simultaneous implantation and annealing for high fluences.

10145 **(SAND—84-1254C) Activation of Si-N modes in silicon by pulsed laser annealing.** Stein, H.J.; Peercy, P.S.; Hills, C.R. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 7p. (CONF-841157—36). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003988.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

Retention and bonding of nitrogen implanted into crystalline Si were examined by infrared absorption (ir) and transmission electron microscopy (TEM) after furnace and pulsed laser annealing. Localized Si-N vibrational modes for N-N pairs are observed, and the associated ir band intensities increase upon pulsed annealing. Furace annealing above 600°C decreases the ir intensity for N-N pairs and fine structure defects appear in TEM. Subsequent laser annealing removes most of the fine structure and reactivates the pair spectrum which we interpret as dissolution of N precipitates and pair formation upon quenching from the melt. Any realistic model for N in Si must include the formation and consequences of N-N pairs.

10146 **(SAND—84-2574C) Further magnetotransport studies of $(TMTSF)_2PF_6$.** Kwak, J.F.; Schirber, J.E.; Chaikin, P.M.; Williams, J.M.; Wang, H.H. (Sandia National Labs., Albuquerque, NM (USA); Pennsylvania Univ., Philadelphia (USA); Argonne National Lab., IL (USA)). 1984. Contract AC04-76DP00789. 10p. (CONF-841210—8). NTIS, PC A02. File Number DE85003949.

From International chemical congress of Pacific Basin Societies; Honolulu, HI, USA (16 Dec 1984).

Hall Effect measurements at 7 kbar confirm earlier magnetoresistance measurements indicating the occurrence of magnetic quantum oscillations with a threshold field. The Hall resistance shows steplike structure similar to that in $(TMTSF)_2ClO_4$, although the step magnitudes are not consistent with the quantum Hall effect. The Hall voltage changes sign near 100 kOe, also similar to an effect reported for the ClO_4 salt, suggesting that the explanation in terms of anion ordering given for that effect is incorrect. Data taken near 6.3 kbar, in a regime where the SDW transition temperature is suppressed by pressure to less than 4K, show a strong increase of the transition temperature in a magnetic field.

10147 **Pulsed excimer (KrF) laser melting of amorphous and crystalline silicon layers.** Narayan, J.; White, C.W.; Aziz, M.J.; Stritzker, B.; Walthuis, A. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Applied Physics;* **57**: No. 2, 564-567(15 Jan 1985).

We have investigated depth of melting as a function of pulse energy density in amorphous and crystalline silicon layers. The melting threshold for KrF laser pulses ($\lambda = 0.249$ μm, tau = 24×10^{-9} s) in amorphous (7660-A-thick) and crystalline silicon layers were determined to be 0.16 +- 0.02 and 0.75 +- 0.05 J cm^{-2}, respectively. The formation of fine- and large-polycrystalline regions was clearly identified in the amorphous silicon layers for energy densities below that needed for complete annealing. The role of explosive recrystallization in the formation of the fine polycrystalline region is discussed.

10148 **Dynamics of fractal colloidal aggregates.** Martin, J.E.; Schaefer, D.W. (Division 1152, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review Letters;* **53**: No. 26, 2457-2460(24 Dec 1984).

Dynamic light-scattering measurements on fractal aggregates of colloidal silica show that the mean decay rate (Rayleigh linewidth) of the intensity autocorrelation function scales like q/sup 2.7/, where q is the momentum transfer. This result is compared to the q^3 prediction for percolation clusters and the more complex results derived here for cluster-cluster aggregation.

10149 **Measurement of Lawrence Livermore National Laboratory of thresholds of samples in the Balzers round-robin laser-damage experiment.** Milam, D. (University of California, Lawrence Livermore National Laboratory, P.O. Box 5508, Livermore, California 94550). *Applied Optics;* **23**: No. 21, 3762-3763(1 Nov 1984). Contract W-7405-ENG-48.

A summary is given of the two experimental procedures used at Livermore to measure 1064-nm 1-nsec laser-damage thresholds of thin films coatings in the Balzers round-robin experiment.

40 CHEMISTRY

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 4001009593, 9594, 9605, 9635, 10177, 10323

10150 **(DOE/ER/60007—T1) Liquid chromatography separation of non-volatile components of fossil fuels at very high resolution. Final report.** Novotny, M.V. (Indiana Univ., Bloomington (USA). Dept. of Chemistry). 1984. Contract AC02-81ER60007. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003923.

Characterization of the non-volatile fractions of various fossil fuels is of technological and environmental importance. The aim of our work is to develop very high efficiency preparative and analytical separations which allow more detailed chemical identification of selected compounds of interest. Using crude synfuel materials as model mixtures, we have evaluated two major sample fractionation approaches and preparative high-pressure liquid chromatography (HPLC) to provide preliminary separation into discrete classes of organic high-molecular-weight compounds. The individual fractions were screened by analytical HPLC for compound overlap and molecular-weight range. In addition, suitable columns and optimum mobile phase compositions have been investigated. A variety of micro-HPLC techniques were evaluated for both crude mixtures and fractionated samples. While loosely packed microcapillaries appear of marginal utility in analyzing complex mixtures, fused-silica capillaries slurry-packed with small particles have recently been studied in our laboratory and possess nearly ideal properties for the investigations. Using these columns, characterization and tentative compound identification through mass spectrometry was accomplished in a model sample, and highly resolved profiles were obtained for several substance classes and fossil-fuel materials. Also, a nanoliter sampling technique, miniaturized gradient-forming device, low dead-volume, nitrogen-sensitive thermionic detector, and miniature amperometric electrochemical detector have been investigated. 16 references, 5 figures, 3 tables.

10151 **(EUR—9209-EN) Certification of polycyclic aromatic compounds. Pt. 5.** Karcher, W.; Fordham, R.J.; Jacob, J.; Colinet, E. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. 53p. Commission of the European Communities, Luxembourg.

The purity of samples of four polycyclic aromatic hydrocarbons and six nitrogen-containing heterocyclics was determined in an interlaboratory exercise, involving eleven laboratories of the EC member countries and one laboratory of the Commission of the EC. The purity analysis was carried out using independent analytical methods (gas liquid chromatography, high performance liquid chromatography and mass spectrometry).

10152 **(IS-M—506) Chemical thermodynamic models to represent the extraction of gallium in the system $GaCl_3$-$AlCl_3$-HCl-H_2O-tributyl phosphate.** Judin, V.P.S.; Bautista, R.G. (Ames Lab., IA (USA)). Dec 1984. Contract W-7405-ENG-82. 12p. (CONF-841210—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003216.

From International chemical congress of Pacific Basin Societies; Honolulu, HI, USA (16 Dec 1984).

The salting-out power of this mixed electrolyte system was successfully interpreted by considering the stability of aluminum chloride complex species and calculating the concentration of free chloride ions actually available for the extraction. Three extraction mechanisms in the range of compositions examined include extraction of $GaCl_3$ at low H^+ and salt concentrations, extraction of $GaCl_4^-$ at moderate H^+ and salt concentrations, and the competition of $GaCl_4^-$ with the complex $HCl.3H_3O.TBP$ at high H^+ and salt concentrations. The extraction of gallium over a wide range of distribution ratios (K/sub D/ = 1 to 1 x 10^4) could be represented by a chemically based model taking into account the free chloride concentration and the activity coefficient of the total chloride ions.

10153 **(IS-T—1156) New laser spectroscopic technique for stable-isotope ratio analysis.** Tong, W.G. (Ames Lab., IA (USA)). Dec 1984. Contract W-7405-ENG-82. 258p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85004485.

A new approach to stable-isotope ratio analysis based on atomic hyperfine structure is demonstrated. This laser spectroscopic scheme is virtually interference-free. A minor constituent in a complex matrix can be selectively analyzed without extensive sample preparation. A single-frequency tunable cw ring dye laser is used as the excitation source and a demountable cathode discharge is used as the atomizer and detector. Samples are electrodeposited on the demountable cathode and hyperfine profiles are collected by optogalvanic detection. By spectral deconvolution, the relative abundances of all isotopes present can be determined with good accuracy and precision. The technique is demonstrated for copper contents as low as 1.6 ppM, using the atomic hyperfine structure of Cu I 578.2 nm non-resonance transition. It is also successfully tested for analysis of copper isotopes in human blood. The sensitivity of doppler-free polarization spectroscopy in atomic flames is showed to be competitive with other sensitive laser techniques such as the fluorescence spectrometric methods. Improved detectability of polarization rotation and excellent suppression of flame background noise enable this method to achieve detection limits of parts per trillion levels of sodium and 37 ppB of barium. The spectral resolution is suitable for isotopic analysis, and the technique offers excellent selectivity and minimum spectral interference.

10154 (NIRS-M—38, pp 43-57) **Problems in treatment of soluble substances in radioautography.** Nagata, Tetsushi (Shinshu Univ., Matsumoto, Nagano (Japan). Faculty of Medicine). 1982. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780072. (CONF-8012126—).

From 12. NIRS seminar on progress of isotope tracer techniques in biology and basic medicine; Anagawa, Chiba, Japan (4 Dec 1980).

The techniques of proving soluble labeled compounds by radioautography with an optical or an electron microscope are described, and the various problems in their treatment are discussed: sedimentation fixation, freezing fixation, cryo-sectioning, freeze-substitution embedding, freeze-dry embedding, dry-sectioning, and emulsion dry application. The problem common to all the techniques, to which careful attention must be paid, is to obtain a radioautogram retaining the soluble labeled compound in a localized position as far as possible by preventing its dissolving-out and diffusion. It is extremely difficult to decide which of the techniques should be actually applied. This also differs with the chacteristics of individual labeled compounds. Therefore, the decision must be made by fully considering the chemical and physical characteristics of the compounds.

10155 (RFP—3627) Some developments for radioanalytical separations. Braun, T.; Bull, P.; Fardy, J.J.; Haiduc, I.; Macasek, F.; McDowell, W.J.; Misak, N.Z.; Navratil, J.D.; Sato, T. (Rockwell International Corp., Golden, CO (USA); Eoetvoes Lorand Tudomanyegyetem, Budapest (Hungary); International Atomic Energy Agency, Vienna (Austria); Commonwealth Scientific and Industrial Research Organization, Sutherland (Australia). Lucas Heights Research Labs.; Babes-Bolyai Univ., Cluj (Romania); Komenskeho Univ., Bratislava (Czechoslovakia)). 1983. Contract AC04-76DP03533. 22p. NTIS, PC A02. File Number DE85003911.

Some recent developments in separation techniques with applications to nuclear analytical methods are summarized. The projects discussed are part of an International Atomic Energy Agency coordinated research programme and cover both fundamental studies of the mechanism of various separation processes, and practical applications of novel radiochemical procedures. The processes include methods of adsorption, ion exchange and solvent extraction. Applications to neutron activation analysis, photon electron rejecting alpha liquid scintillation spectrometry and x-ray fluorescence spectrometry are described.

10156 (SVF—140) Investigations on humic substances in natural waters. Josefsson, B.; Plechanov, N. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Jun 1983. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85750200.

In the present work gram quantities of fulvic and humic acids have been isolated from natural waters using an anion-exchange resin as well as XAD-7 adsorbent. The samples obtained have been subjected to a systematic investigation by physico-chemical methods in order to better understand the structure and properties of water-soluble humic substances and their role in the aquatic environment. Humic acids and fulvic acids were isolated from waters of Goeta River (relatively polluted) and Finnsjoen (lake, unpolluted). From the results obtained the following conclusions can be drawn. 1. Concentration of water-soluble humic substances (WSHS) by using anion-exchange resin or molecular adsorbent resulted in quantitative rather than qualitative differences in the composition of the materials isolated. 2. The composition of WSHS suggests that they at least in part originate from lignin. 3. The lignin component in WSHS from polluted waters might be derived from lignosulfonic acids. 4. ^1H NMR results suggest that WSHS in addition to lignin-derived compounds contain varying amounts of a second group of materials characterized by the presence of alkyl groups. 5. The molecular weight distributions of humic acids and fulvic acids are rather similar. 6. A model based on the equation of Tanford is found to describe quantitatively the proton-binding equilibria for the water soluble humic substances.

4002 Inorganic And Physical Chemistry

REFER ALSO TO CITATION(S) 4002009460, 9641, 10170, 10173

10157 (DOE/ER/10381—6) Synthesis, static, and reactive characterization of supported organometallics. Progress report. Brenner, A. (Wayne State Univ., Detroit, MI (USA). Dept. of Chemistry). 23 Nov 1984. Contract AC02-79ER10381. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004285.

The primary impetus was the development and evaluation of new catalysts prepared by the thermal and photolytic activation of organometallic complexes directly deposited on high surface area refractory supports. Emphasis was placed on the use of carbonly complexes decomposed on alumina and in comparing the activity of these materials to traditional catalysts prepared by the reduction of salts. Specific goals were to (1) extend previous studies of temperature programmed decomposition (TPDE) and characterization of the resulting catalysts; (2) extend the model reactions to include benzene hydrogenation and possibly other reactions; (3) study photolytic activation as an alternative to thermal decarbonylation of supported complexes; (4) develop the concept of reactive characterization.

10158 (DOE/ER/13299—1) [Diosmacycloalkanes as models for the formation of hydrocarbons form surface methylenes]. Progress report, September 1, 1984-March 31, 1985. Norton, J.R. (Colorado State Univ., Fort Collins (USA). Dept. of Chemistry). 1985. Contract FG02-84ER13299. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004883.

Improvements have been made in the synthetic approaches to diosmacycloalkanes. (DLC)

10159 (DOE/PC/60779—5) Advanced NMR characterization of zeolite catalysts. Fifth quarterly report, 1 October-31 December 1984. Welsh, L.B. (Signal UOP, Inc., Des Plaines, IL (USA). Research Center). Jan 1985. Contract FG22-83PC60779. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004975.

The main efforts during the fifth three-month period of the program have been the computer simulations of the static, MASS, and VASS ^{17}O NMR spectra obtained earlier. The complex ^{17}O NMR spectrum can be simulated by two quadrupolar spectra, one coming from oxygen in a Si-O-Si configuration and one from oxygen in an Ai-O-Si configuration. Good simulations have been obtained for zeolite A (only Si-O-Al), dealuminated zeolite Y (mainly Si-O-Si) and zeolite Y with a Si/Al ratio of about 2.8. 2 references, 2 tables.

10160 (IS-T—1117) Electrochemical dissolution of copper sulfides using a fluidized bed electrochemical reactor. Felker, D.L. (Ames Lab., IA (USA)). Dec 1984. Contract W-7405-ENG-82. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85005117.

A 2-stage process for the separation and recovery of the Cu, Fe and S from chalcopyrite ($CuFeS_2$) was investigated. The overall process dissolves and separates the Cu and Fe in $CuFeS_2$ into a Fe rich electrolyte and a Cu rich electrolyte. The S in $CuFeS_2$ reacts to form H_2S and S^0. A model was developed to explain the results of the chalcopyrite reduction experiments, based on the assumptions that the rate of chalcopyrite reduction is controlled by the H^+ content at the reacting surface/electrolyte interface and the H^+ content at the interface is controlled by the diffusion of H^+ through the porous chalcopyrite reduction product layer. The model is in general agreement with the experimental results. Production of Cu (I) during the dissolution of the chalcopyrite reduction product layer occured only when using a 4 M HCl anolyte. The amount of Cu (I) produced fell sharply when the total cell current exceeded 19.5 A. Complete oxidation of the copper sulfide layer was easily accomplished. Oxidation of the chalcopyrite reduction product layer was possible in 4 M $HClO_4$, 2 M H_2SO_4 and 2.7 M H_3PO_4, except that Cu (II) was the only dissolution product and dissolution of the copper sulfide was replaced by O_2 evolution when the solid phase stoichiometry reached CuS. Addition of Cl^- to the electrolyte prevented the production of O_2 and caused the CuS to react, forming Cu (II) and S^0. The presence of Cl^- also caused the evolution of Cl_2. The chalcopyrite reduction product layer produced in 4 M HCl was identified as Cu/sub 1.8/S. The rate of chalcopyrite reduction was severely limited by the thickness of the Cu/sub 1.8/S product layer. Removal of the chalcopyrite reduction product layer using an ultrasonic bath showed that a product layer material containing up to 15 times more Cu than Fe could be recovered.

10161 (IS-T—1153) Extensions of the full optimized reaction space model for molecular electronic wavefunctions. Lam, M.B. (Ames Lab., IA (USA)). Dec 1984. Contract W-7405-ENG-82. 203p. NTIS, PC A10/MF A01; GPO Dep. File Number DE85005116.

Thesis.

Results of multi-configuration self-consistent-field (MCSCF) calculations using FORS wavefunctions are discussed for the low-lying electronic states of allene at planar geometries. Two possible augmentations to the FORS model are developed. The first is a semi-empirical correction method, termed the IntraAtomic Correlation Correction (IACC) model where FORS wavefunctions are expressed in terms of configurations, generated from localized molecular orbitals, which have the character of atomic states. With the help of these expansions, correlation corrections, available from

atoms, are transferred to the molecular wavefunctions. The second augmentation consists of improving the FORS wavefunction by the systematic inclusion of additional configurations involving orbitals outside the valence space. The effectiveness of both approaches is demonstrated by applications to a series of diatomic molecules.

10162 **(LBL—13346) Application of powerful oxidizers in the synthesis of new high-oxidation state actinide and related species.** Yeh, S.M. (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 169p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85005107.

The fluorinating and oxide scavenging ability of XeF_6 have been studied by bringing XeF_6 into interaction with oxide-fluoride compounds of the third-transition-series elements (W, Re and Os) and uranium, in their highest oxidation states. $A^+MOF_5^-$ and $A^+M_3O_2F_9^-$ (A = K or Cs, M = W or U) were converted to $A^+MF_7^-$ by XeF_6, but the rhenium and osmium compounds, $K^+ReO_3F_4^-$ and $XeF_5^+OsO_3F_3^-$, resisted interaction with XeF_6. Strong interactions between XeF_2 or KrF_2 and the solvent have been observed for their solutions in anhydrous HF. Both XeF_2 and KrF_2 are seen to be effective in breaking up the polymeric (HF)/sub n/ chains. Only weak interactions occur between cations and anions of $KrF^+AuF_6^-$ and $Kr_2F_3^+AuF_6^-$ in HF. The AuF_6^- anions are slightly distorted from O/sub h/ symmetry. $Kr_2F_3^+$ cations in HF have the same dissymmetric V-shape which occurs in crystalline salts. A low-temperature orthorhombic form, β-$ReF_6^+SbF_6^-$, a high-temperature rhombohedral form, α-$ReF_6^+SbF_6^-$, and a $ReF_6^+AuF_6^-$ have been prepared. These compounds possess only kinetic stability at ambient temperature and at ~ 20°C are best represented as $ReF_6^+ReF_7MF_6^-MF_5$. Thermochemical energy evaluations indicate that the ionization potential of ReF_6 is 261 kcal $mole^{-1}$ and that the fluoride-ion affinity of ReF_6^+ is -214 kcal $mole^{-1}$. This is more exothermal than the corresponding process for IF_6^+ (-208 kcal $mole^{-1}$). In contrast, $ReOF_5$ is shown to be a better fluoro-base than IOF_5 and also is a better base than ReF_7. $ReOF_4^+MF_6^-$ (M = Sb, Au and As) salts are of higher thermal stability than their $ReF_6^+MF_6^-$ analogues.

10163 **(LBL—18549) Ion-enhanced chemical reaction of XeF_2 with silicon by modulated molecular beam mass spectrometry.** Balooch, M.; Olander, D.R.; Siekhaus, W.J. (Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 12p. (CONF-841157—34). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005165.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

The reaction of XeF_2 with the Si(100) surface was studied by modulated (10-1000 Hz) molecular beam-mass spectrometry in the temperature range 300-1300K and equivalent XeF_2 pressure of $5x10^{-6}$ to 10^{-4} torr. Simultaneous bombardment of the reacting surface by Ar^+ was used to determine the extent of ion-enhancement of the reaction. In the absence of the ion beam, the main reaction product was SiF_4, which was formed with a reaction probability of ~ $5x10^{-3}$ at room temperature. In the presence of the ion beam three-products, SiF_4, SiF_2 and F_2 (or F), were detected with formation probabilities of ~ $1x10^{1}$, $6x10^{-2}$ and $7x10^{-2}$ respectively. Increasing surface temperature reduced theion-enhanced reactivity.

10164 **(LBL—18727) [8]annulene complexes of the lanthanides.** Kinsley, S.A. (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 208p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85003781.

The infrared spectra of [8]annulene sandwich complexes in the 600 to 1000 cm^{-1} region can be indicative of an eclipsed arrangement of the [8]annulene rings. The vibrations in this involve only CH an CC movement, not ring-metal displacement, as suggested by Goffart. For two [8]annulene sandwich complexes involving same central metal atoms in different oxidation states, the position of the p(CH),A/sub 2u/ and the B(CH), E/sub 1u/ are expected to occur at a higher frequency for the molecular with the central metal atom in the higher oxidation state. The shifts in frequency in the bands in the 600 to 1000 cm^{-1} range can be explained in terms of the ionic radii of the central metal atom. Thus, no conclusions on the amount of ring-metal orbital interactions in bis([8]annulene) sandwich complexes can be drawn by consideration of their infrared spectra in the 600 to 1000 cm^{-1} range.

10165 **(LBL—18730) Methyltrihydroborate complexes of the lanthanides and actinides.** Shinomoto, R.S. (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 172p. NTIS, PC A08/MF A01; GPO Dep. File Number DE85005156.

Thesis.

Reaction of MCl_4 (M = Zr, Hf, U, Th, Np) with $LiBH_3CH_3$ in chlorobenzene produces volatile, hexane-soluble $M(BH_3CH_3)_4$. Crystal structures are monomeric, tetrahedral species. Lewis base adducts prepared include $U(BH_3CH_3)_4$.THT, $Th(BH_3CH_3)_4$.L (L = THF (tetrahydrofuran), THT (tetrahydrothiophene), SMe_2, OMe_2), $U(BH_3CH_3)_4$.2L (L = THF, pyridine, NH_3), $Th(BH_3CH_3)_4$.2L (L = THF, THT, py, NH_3), $M(BH_3CH_3)_4$.L-L (M = U, Th; L-L = dme (1,2-dimethoxyethane), bmte (bis(1,2-methylthio)ethane), tmed (N,N,N',N'-tetramethylethylenediamine), dmpe (1,2-dimethylphosphinoethane)) and $Th(BH_3CH_3)_4$.1/2 OEt_2. Reaction of MCl_3 (M = Ho, Yb, Lu) with $LiBH_3CH_3$ in diethyl ether produces volatile, toluene-soluble $M(BH_3CH_3)_3.OEt_2$. Other Lewis base adducts prepared from $M(BH_3CH_3)_3.OEt_2$ include $Ho(BH_3CH_3)_3$.L (L = THT, THF, py), $Ho(BH_3CH_3)_3$.2L (L = THT, THF, py), $Ho(BH_3CH_3)_3$.tmed, $Ho(BH_3CH_3)_3$.3/2 L-L (L-L = dmpe, bmte), $Yb(BH_3CH_3)_3$.3/2 dmpe, $Yb(BH_3Ch_3)$.L (L = THF, dme), $Yb(BH_3CH_3)_3$.2THF, and $Lu(BH_3CH_3)_3$.THF. By structural criteria, the bonding in actinide and lanthanide methyltrihydroborate complexes is primarily ionic in character even though they display covalent-like physical properties. Spectroscopic measurements indicate that there is some degree of covalent bonding in $U(BH_3CH_3)_4$.

10166 **(ORNL/TM—9180) Chemical and physical properties of dimethyl sulfoxide-water-metal chloride systems.** Pruett, D.J.; Felker, L.K. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 69p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004950.

The densities of binary mixtures of dimethyl sulfoxide (DMSO) and water were measured over the entire range of composition (0 to 100 wt %) at 25, 40, and 60°C. These data were compared with results previously obtained at 25, 45, and 65°C and were used to develop empirical equations for calculating the density of a DMSO-H_2O mixture of any composition at these temperatures. The apparent molar volume of each component was also calculated, and equations were derived to describe the variation in partial molar volume as a function of concentration of either component. The solubility of inorganic chlorides in DMSO nad DMSO-H_2O mixtures, densities were measured and phase diagrams were prepared for DMSO-H_2O-$CaCl_2$, DMSO-H_2O-NaCl, and DMSO-H_2O-NH_4Cl mixtures at 25, 40, and 60°C. The data obtained indicate that the size of the solution region is a strong function of temeperature in the $CaCl_2$ system but does not vary significantly between 25 and 60°C in the NaCl and NH_4Cl systems. After the solution region for each of the systems has been defined, the solubilities of the chlorides of Pb, Ag, Au, Cd, Cu, Zn, and Al were determined under a number of conditions. The resulting data were compared with those previously reported, and the potential of the three systems for separating these metals was then evaluated.

10167 **(RFP—3705) Production and recovery of Americium-241.** Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1984. Contract AC04-76DP03533. 10p. (CONF-841229—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004972.

From International symposium on americium and curium science and technology; Honolulu, HI, USA (16 Dec 1984).

Americium-241, one of the most useful actinide isotopes, is produced as a by-product of plutonium scrap recovery operations. Rocky Flats (RF) has supplied high-purity americium oxide to the US Department of Energy's Isotope Pool since 1962. Over the years, the evolving separation and purification processes have included such diverse operations as aqueous precipitation, ion exchange, and both molten-salt and organic-solvent extraction. A review is presented of the production and recovery processes of americium-241. 5 references.

10168 **(RFP—3714) Actinide physicochemical data assessment and selection.** Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1984. Contract AC04-76DP03533. 10p. (CONF-8406139—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE85005185.

From 9. international CODATA conference; Jerusalem, Israel (24 Jun 1984).

There is a continuing need to have reliable physicochemical data of actinide compounds and actinide elements in aqueous solution available for nuclear engineers and scientists. These data are needed for all aspects of the nuclear fuel cycle - from the behavior of actinides in reactor fuels at high temperature and pressure to actinide behavior in geologic depository environments. This paper summarizes the status of actinide physicochemical data assessment and selection. The topics to be covered include data assessment of chemical thermodynamic properties and solubilities of actinide compounds and solution equilibria of the actinides.

10169 **Isoplestic determination of the osmotic coefficients of aqueous H_2SO_4 at 25°C.** Rard, J.A. (Lawrence Livermore National Lab., CA). *Journal of Chemical and Engineering Data;* **28**: No. 4, 384-387(1983). Contract W-7405-ENG-48.

The osmotic coefficients of aqueous H_2SO_4 have been measured from 0.35 to 4.36 mol kg^{-1} at 25°C with the isoplestic method, using NaCl as the reference solution. Previously published results from this laboratory extend this concentration range down to 0.14 mol kg^{-1}. The purpose was to refine the osmotic coefficients of this important isoplestic standard. These new data are compared to published thermodynamic data for H_2SO_4 solutions, and some published low-concentration isoplestic data were found to be inaccurate. An assessment is made as to which published data are more reliable, and recommendations are made as to which should be given greater weight in future evaluations.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 4003009462, 9573,' 10064, 10064, 10070, 10156, 10161

10170 **(DOE/PC/60812—T2) Catalysts possessing augmented C-O and C-N hydrogenolysis activity. Progress report No. 2, January-March 1984.** Massoth, F.E.; Shabtai, J.S. (Utah Univ., Salt Lake City (USA). Dept. of Fuels Engineering). 9 Apr 1984. Contract FG22-83PC60812. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004238.

The aim of the proposed research is to synthesize and investigate new sulfided catalyst systems having higher carbon-heteroatom hydrogenolysis activity as compared to ring hydrogenation activity. A fundamental approach is planned to gain understanding of the basic catalytic properties which relate to hydrogenolysis, hydrogenation and cracking functions of the catalysts. This will involve preparation of new catalysts, characterization of their properties and model compound reactivity studies. In another part of the project, selected catalysts will be applied in studies of more complex O- and N-containing model compounds with the objective of providing fundamental data on the stereochemistry of HDO and HDN reactions. These data will be used to develop steric surface-reactant models for sulfided catalysts. These new catalysts should be of particular importance for upgrading of coal-derived liquids and solids, as well as other heavy feedstocks. The research is divided into four tasks: A-catalyst preparation and activity testing; B-catalyst characterization; C-study of catalyst activity and functional selectivity under hydroprocessing conditions; and D-stereochemical studies. Catalysts containing Co, Ni, Mo and/or Cr of different compositions supported on γ-alumina were prepared and tested for their hydrodeoxygenation (HDO) and hydronitrogenation (HDN) activities using the model compounds dibenzofuran and indole. 4 references, 5 figures, 1 table.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 4004009648

10171 **(IS-T—1129) Application of modulated hydrodynamic voltammetry to the study of anodic electrocatalysis.** Austin, D.S. (Ames Lab., IA (USA)). Dec 1984. Contract W-7405-ENG-82. 204p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85004182.

Square-wave hydrodynamically modulated voltammetry (QHMV) is used for the study of anodic reactions electrocatalyzed by surface oxides at noble metal electrodes. QHMV permits extraction of the convective-coupled faradaic component from the total electrode current. The positive potential limit for application of QHMV is observed to be 200 to 400 mV more positive than that for conventional cyclic voltammetry, depending on the electrode material. Small mass-transport coupled currents occurring simultaneously with oxide formation and O_2 evolution can be characterized voltammetrically by application of QHMV. Results obained by cyclic voltammetry and QHMV are described for several anoidic reactions at various noble metal electrodes. Major emphasis is placed on the anodic behavior of I^- at a Pt electrode in acidic media. The convective components of the total electrode current include the mass-transport limited production of I_2 (0.55 V); the mass-transport coupled oxidation of I^- to IO_3^- (1.0 to 1.1 V), which is catalyzed by the anodic formation of PtOH; and the mass-transport limited formation of IO_3^- (1.5 V) which is electrocatalyzed by an OH intermediate product of O_2 evolution. Results on the catalytic reduction of IO_3^- at a Pt electrode are described briefly. Data obtained for the anodic detection of I^- are presetned for the application of constant and multi-step potential amperometry.

10172 **The anodic reaction of sulfide ions at graphite electrodes in molten cryolite.** Minh, N.G.; Yao, N.P. (Argonne National Laboratory, Chemical Technology Division, Argonne, Illinois). *Journal of the Electrochemical Society;* **131**: No. 10, 2279-2282(Oct 1984).

The anodic reaction of sulfide ions at graphite electrodes in molten cryolite has been studied by cyclic voltammetry at 1323 K. The anodic reaction is found to proceed via a quasi-reversible mechanism, i.e., one in which the current is controlled by both diffusion and charge transfer kinetics. The apparent diffusion coefficient for sulfide ions in cryolite at 1323 K is about 3.93 X 10^{-5} cm^2/S.

10173 **Energetics of reaction of Al^{3+} with O^{2-} in an alkali halide environment.** Curtiss, L.A.; Blander, M. (Argonne National Laboratory, Chemical Technology Division, Argonne, Illinois). *Journal of the Electrochemical Society;* **131**: No. 10, 2271-2273(Oct 1984).

Ab initio molecular orbital calculations of the structures and energies of $LiAlF_4$, Li_3O, $LiAlCl_4$ and Li_3AlF_3O are presented. These molecules were chosen so as to approximate Al^{3+} and O^{2-} in a molten salt environment. Calculated energies for vapor-phase reactions involving oxide addition to $LiAlX_4$ (X = F, Cl) are consistent with experimental data from molten halide melts. Comparison is also made between the quantum mechanical calculations and results from simple coulomb models.

4005 Photochemistry

10174 **(DOE/ER/04940—2) Laser enhanced chemical reaction studies. Technical progress report, January 1, 1982-October 31, 1984.** Flynn, G. (Columbia Univ., New York (USA). Dept. of Chemistry). 1984. Contract AC02-78ER04940. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005008.

Experimental studies of dynamic molecular processes are described with particular emphasis on the development of a powerful new infrared diode laser probe technique. This technique allows us to determine the final states of CO_2 (and other molecules) produced by collisions, photofragmentation, or chemical reactions with a spectral resolution of 0.001 cm^{-1} and a time resolution of 10^{-7} s. Such high spectral resolution provides a detailed picture of the vi-

brational and rotational states of molecules produced by these dynamic events. We have used this experimental method to probe collisions between hot hydrogen atoms and CO_2 and to study the final state energy distribution of CO_2 produced as a result of photodissociation of pyruvic acid. Infrared and uv fluorescence technique have also been used to investigate collisions between hot hydrogen atoms and CO, CO_2, CH_3F; photofragmentation of 1,3,5-triazine; chemical reactions between hot hydrogen atoms and N_2O; photochemical studies of Br_2 trapped in rare gas matrices; infrared multiphoton dissociation of C_4F_8; and vibrational relaxtion of $(COF)_2$. Progress in these interconnected experimental areas is briefly described.

10175 (DOE/ER/13213—T1) Laser studies of the dynamics of free radical reactions. Final report. Jackson, W.M. (Howard Univ., Washington, DC (USA). Dept. of Chemistry). 30 Oct 1984. Contract FG05-84ER13213. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85005177.

This proposal describes experiments to study the effects of vibrational energy on the rate constants for the reactions of CN with various hydrocarbons. The aim is to obtain enough detailed information so that the rate constants can be predicted for a wide variety of systems. The rate constant for ten hydrocarbons has been obtained at room temperature. We expect to extend these measurements to other temperatures so that the activation energies for individual reactions can be determined. In addition to measuring the activation energies, we will determine the branching ratios for various chemical products by using techniques such as product analysis, laser induced fluorescence and resonance atom detection.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 4006009613

10176 (DOE/ET/00913—3) Contribution of electronically excited states to the radiation chemistry of organic systems. Progress report, December 1, 1981-November 30, 1984. Lipsky, S. (Minnesota Univ., Minneapolis (USA)). 1984. Contract AC02-76ER00913. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004311.

The fluorescence of saturated hydrocarbon liquids excited by ^{85}Kr beta particles has been studied as a function of the concentration of electron scavenger. It has been possible to extract the probability, p^+, that the scavengers attach a geminate electron. The effect of N,N,N',N'-tetramethyl-p-phenylenediamine (TMPD) to scavenge geminate positive ions in irradiated hydrocarbon liquids has been studied via examination of the recombination fluorescence of $TMPD^+ + e^-$ as a function of TMPD concentration. The scavenging probability p^+ is found to be simply proportional to c. An effect of electron scavengers to reduce the photocurrent from TMPD excited optically above its ionization threshold in nonpolar liquids has been observed and explained in terms of interaction of the scavenger with epithermal electrons. The field and temperature dependences of the photocurrent has been studied in the presence and absence of electron scavengers and the results support the epithermal model. The fractional reduction in TMPD fluorescence in liquid tetramethylsilane caused by imposition of an electric field has been studied as a function of excitation energy (above the photoionization threshold) and as a function of field strength. It has been possible to extract the photoionization quantum yield and the electron thermalization range from $\simeq$ 5.5 eV to 7.5 eV. From an absolute measurement of the yield of excited solute states in irradiated benzene and comparison with optical measurements, it is concluded that the energy transfer efficiency is representable by a Stern-Volmer function that extrapolates to unity at infinite solute concentration. The excimer to monomer ratio in photoexcited polystyrene in solution is found not to depend on polystyrene concentration.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 4007009595

10177 (DOE/OR/21400—T78) Gram-scale separation of curium from americium using alpha-hydroxyisobutyric acid in high-pressure cation columns. Bigelow, J.E.; Benker, D.E.; Chattin, F.R.; King, L.J.; Knauer, J.B.; Ross, R.G.; Stacy, R.G.; Wiggins, J.T. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004427.

Quantities of heavy element (americium and curium) up to 2.3 g have been successfully separated by chromatographic elution from cation resin using alpha-hydroxyisobutyrate in equipment originally designed for decigram-scale separations of ^{253}Cf and heavier elements. The high-pressure ion exchange process was reliable and relatively easy to operate. Overall curium recoveries of 80 to 90% were readily achieved with decontamination from americium by factors of 400 to 500. The product and waste streams are both in forms readily coupled to further processing steps.

10178 (K/PS—915) Characterization of the solid, airborne materials created by the interaction of UF_6 with atmospheric moisture in a contained volume. Pickrell, P.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Dec 1984. Contract AC05-84OT21400. 51p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004790.

Several experiments have been performed in which UF_6 was released into air under static conditions in a 6 m^3 release chamber in order to characterize the solid products of hydrolysis as the amount of UF_6 released was increased. An aerosol concentration of $\sim$ 25 gm/m^3 (150 gm) was the largest achieved. Electron microscopy was used to determine the morphology of the aerosol particles and to obtain geometric size measurements from micrographs and a cascaded impactor was used to obtain aerodynamic size measurements by measuring particle masses. Particle sizes and rate of particle size change were observed to be dependent on aerosol concentration.

10179 (LA-UR—84-3755) Americium metal preparation on the multigram scale. Reavis, J.G.; Apgar, S.A. III; Mullins, L.J. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 14p. (CONF-841210—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003735.

From International chemical congress of Pacific Basin Societies; Honolulu, HI, USA (16 Dec 1984).

It was demonstrated that americium metal of approximately 99.5% purity can be produced on the 20- to 25-g scale by lanthanum reduction of the oxide in a very simple apparatus. As predicted from relative vapor pressures, volatile metal impurities such as calcium and magnesium accompany the americium during distillation. The major impurity detected was lanthanum at a concentration predicted for the equilibrium vapor composition above lanthanum metal containing 1% americium. It is speculated that higher purity americium might be produced if distillation were to be discontinued earlier, with no attempt at quantitative recovery of the metal.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

10180 (N—84-20530) Measurement of spray combustion processes. Peters, C.E.; Arman, E.F.; Hornkohl, J.O.; Farmer, W.M. (Tennessee Univ., Tullahoma (USA). Space Inst.). Apr 1984. 4p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 47-50, N—84-20525 11-07.

A free jet configuration was chosen for measuring noncombusting spray fields and hydrocarbon-air spray flames in an effort to develop computational models of the dynamic interaction between droplets and the gas phase and to verify and refine numerical models of the entire spray combustion process. The development of a spray combustion facility is described including techniques for

laser measurements in spray combustion environments and methods for data acquisition, processing, displaying, and interpretation.

10181 (N—84-20532) Predictions of spray combustion interactions. Shuen, J.S.; Solomon, A.S.P.; Faeth, G.M. (Pennsylvania State Univ., University Park (USA)). Apr 1984. 12p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 55-66, N—84-20525 11-07.

Mean and fluctuating phase velocities mean particle mass flux particle size and mean gas-phase Reynolds stress, composition and temperature were measured in stationary, turbulent, axisymmetric, and flows which conform to the boundary layer approximations while having well-defined initial and boundary conditions in dilute particle-laden jets, nonevaporating sprays, and evaporating sprays injected into a still air environment. Three models of the processes, typical of current practice, were evaluated. The local homogeneous flow and deterministic separated flow models did not provide very satisfactory predictions over the present data base. In contrast, the stochastic separated flow model generally provided good predictions and appears to be an attractive approach for treating nonlinear interphase transport processes in turbulent flows containing particles (drops).

10182 (N—84-20534) Combustion characteristics in the transition region of liquid fuel sprays. Cernansky, N.P.; Namer, I.; Tidona, R.J.; Sarv, H. (Drexel Univ., Philadelphia, PA (USA)). Apr 1984. 4p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 77-80, N—84-20525 11-07.

A monodisperse aerosol generator was modified to study ignition requirements, flammability limits, and flame speeds in the transition region. An ignition system was developed and tested. The fabrication of an optical drop sizing system is nearly complete. Preliminary measurements of droplet size effects on the minimum ignition energy for n-heptane sprays performed. Parameteric studies of droplet size effects on minimum ignition energies of various fuels including alcohols are in progress.

10183 (N—84-20535) Turbulent swirling combustion. Sommer, H.T.; Mosula, R.J.; Seiden, E. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). Apr 1984. 2p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 81-82, N—84-20525 11-07.

The non-reacting flow produced by two confined, co- and/or counter-swirling jets wre measured by means of a two-color laser Doppler velocimeter. These results are compared with earlier experiments and with numerical predictions. It is shown that under both swirl conditions, a closed recirculation zone is created at the combustor center line. This zone is characterized by the presence of a one-cell toroidal vortex, low tangential velocities, high turbulent intensity, and large dissipation rates of the kinetic energy of turbulence.

10184 (N—84-20552) Lean limit phenomena. Law, C.K. (Northwestern Univ., Evanston, IL (USA)). Apr 1984. 7p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 243-249, N—84-20525 11-07.

The concept of flammability limits in the presence of flame interaction, and the existence of negative flame speeds are discussed. Downstream interaction between two counterflow premixed flames of different stoichiometries are experimentally studied. Various flame configurations are observed and quantified these include the binary system of two lean or rich flames, the triplet system of a lean and a rich flame separated by a diffusion flame, and single diffusion flames with some degree of premixedness. Extinction limits are determined for methane/air and butane/air mixtures over the entire range of mixture concentrations. The results show that the extent of flame interaction depends on the separation distance between the flames which are functions of the mixtures concentrations, the stretch rate, and the effective Lewis numbers (Le). In particular, in a positively-stretched flow field Le 1 (1) mixtures tend to interact strongly (weakly), while the converse holds for flames in a negatively-stretched flow. Also established was the existence of negative flames whose propagation velocity is in the same general direction as that of the bulk convective flow, being supported by diffusion alone. Their existence demonstrates the tendency of flames to resist extinction, and further emphasizes the possibility of very lean or rich mixtures to undergo combustion.

10185 (N—84-20553) Interactive computer modeling of combustion chemistry and coalescence-dispersion modeling of turbulent combustion. Pratt, D.T. (Washington Univ., Seattle (USA)). Apr 1984. 5p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 251-255, N—84-20525 11-07.

An interactive computer code for simulation of a high-intensity turbulent combustor as a single point inhomogeneous stirred reactor was developed from an existing batch processing computer code CDPSR. The interactive CDPSR code was used as a guide for interpretation and direction of DOE-sponsored companion experiments utilizing Xenon tracer with optical laser diagnostic techniques to experimentally determine the appropriate mixing frequency, and for validation of CDPSR as a mixing-chemistry model for a laboratory jet-stirred reactor. The coalescence-dispersion model for finite rate mixing was incorporated into an existing interactive code AVCO-MARK I, to enable simulation of a combustor as a modular array of stirred flow and plug flow elements, each having a prescribed finite mixing frequency, or axial distribution of mixing frequency, as appropriate. Further increase the speed and reliability of the batch kinetics integrator code CREKID was increased by rewriting in vectorized form for execution on a vector or parallel processor, and by incorporating numerical techniques which enhance execution speed by permitting specification of a very low accuracy tolerance.

10186 (N—84-20554) Fast algorithms for combustion kinetics calculations: a comparison. Radhakrishnan, K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1984. 11p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 257-267, N—84-20525 11-07.

To identify the fastest algorithm currently available for the numerical integration of chemical kinetic rate equations, several algorithms were examined. Findings to date are summarized. The algorithms examined include two general-purpose codes EPISODE and LSODE and three special-purpose (for chemical kinetic calculations) codes CHEMEQ, CRK1D, and GCKP84. In addition, an explicit Runge-Kutta-Merson differential equation solver (IMSL Routine DASCRU) is used to illustrate the problems associated with integrating chemical kinetic rate equations by a classical method. Algorithms were applied to two test problems drawn from combustion kinetics. These problems included all three combustion regimes: induction, heat release and equilibration. Variations of the temperature and species mole fraction are given with time for test problems 1 and 2, respectively. Both test problems were integrated over a time interval of 1 ms in order to obtain near-equilibration of all species and temperature. Of the codes examined in this study, only CREK1D and GCDP84 were written explicitly for integrating exothermic, non-isothermal combustion rate equations. These therefore have built-in procedures for calculating the temperature.

10187 (N—84-20557) Spontaneous ignition characteristics of gaseous hydrocarbon-air mixtures. Freeman, G.; Lefebvre, A.H. (Purdue Univ., Lafayette, IN (USA)). Apr 1984. 12p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 285-296, N—84-20525 11-07.

Experiments are conducted to determine the spontaneous ignition delay times of gaseous propane, kerosine vapor, and n-heptane vapor in mixtures with air, and oxygen-enriched air, at atmospheric pressure. Over a range of equivalence ratios from 0.2 to 0.8 it is found that ignition delay times are sensibly independent of fuel concentration. However, the results indicate a strong dependence of delay times on oxygen concentration. The experimental data for kerosine and propane demonstrate very close agreement with the results obtained previously by Mullins and Lezberg respectively.

10188 (N—84-21676) Simulation of the ignition of a mixture of hydrogen and oxygen. Deweille, J.R. (Prins Maurits Lab. TNO, Rijswijk (Netherlands)). Jun 1983. 33p. (PML—1983-34; TDCK—78612). NTIS, PC A03/MF A01.

A numerical model simulating the combustion of a H2-O2 mixture in N2 in a closed cylinder is discussed. The model consists of three program modules which describe the burning gas reaction kinetics, the diffusion of reaction products in the mixture, and gas flow within the container. The gas kinetics part of the program differs from data obtained from experiments on ignition time. Unless considerable numerical diffusion is allowed, ever increasing discontinuities develop with simulation time in the flow pattern. These discontinuities impede a realistic evolution of the gas flow. (ESA)

10189 (N—84-21677) Shock tube study of the fuel structure effects on the chemical kinetic mechanisms responsible for soot formation. Frenklach, M. (Louisiana State Univ., Baton Rouge (USA)). Nov 1983. 100p. (NASA-CR—174661). NTIS, PC A05/MF A01.

Soot formation in toluene-, benzene-, and acetylene-oxygen-argon mixtures was investigated to study soot formation in a combustion environment. High concentrations of oxygen completely suppress soot formation. The addition of oxygen at relatively low concentrations uniformly suppresses soot formation at high pressures, while at relatively lower pressures it suppresses soot formation at higher temperatures while promoting soot production at lower temperatures. The observed behavior indicates that oxidation reactions compete with ring fragmentation. The main conclusion to be drawn from the results is that the soot formation mechanism is probably the same for the pyrolysis and oxidation of hydrocarbons. That is, the addition of oxygen does not alter the soot route but rather promotes or inhibits this route by means of competitive reactions. An approach to empirical modeling of soot formation during pyrolysis of aromatic hydrocarbons is also presented.

10190 (N—842-0555) Role of surface generated radicals in catalytic combustion. Santavicca, D.A.; Stein, Y.; Royce, B.S.H. (Princeton Univ., NJ (USA)). Apr 1984. 6p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 269-274, N—84-20525 11-07.

The role of surface generated OH radicals in determining the catalytic ignition characteristics for propane oxidation on platinum were studied. The experiments were conducted in a stacked-plate, catalyst bed. Transient measurements, during catalytic ignition, of the catalyst's axial temperature profile were made and the effect of equivalence ratio, inlet temperature and inlet velocity was investigated. These measurements will provide insights which will be useful in planning and interpreting to OH measurements. Attempts to measure OH concentration in the catalyst bed using resonance absorption spectroscopy were unsuccessful, indicating that OH concentrations are below 10 to the 16th power/cc but still possibly above equilibrium values. Measurements are currently underway using forward scatter laser induced fluorescence which should extend the OH detection limits several orders of magnitude below the equilibrium concentrations.

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4201 General Engineering

10191 (N—84-25058) Status of plasma physics techniques for the deposition of tribological coatings. Spalvins, T. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1984. 22p. NTIS, PC A17/MF A01.

In Tribology in the 80's, Volume 2, 729-750, N—84-25047 15-37.

The plasma physics deposition techniques of sputtering and ion-plating are reviewed. Their characteristics and potentials are discussed in terms of synthesis or deposition of tribological coatings. Since the glow discharge or plasma generated in the conventional sputtering and ion-plating techniques has a low ionization efficiency, rapid advances have been made in equipment design to further increase the ionization efficiency. The enhanced ionization favorably affects the nucleation and growth sequence of the coating. This leads to improved adherence and coherence, higher density, favorable morphological growth, and reduced internal stresses in the coatings. As a result, desirable coating characteristics can be precision tailored. Tribological coating characteristics of sputtered solid film lubricants such as MoS2, ion-plated soft gold and lead metallic films, and sputtered and ion-plated wear-resistant refractory compound films such as nitrides and carbides are discussed.

10192 (SAND—84-2384C) Comments on continuum modeling of evolving crack distributions in solids. Davison, L. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 13p. (CONF-8411109—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004292.

From Workshop on inelastic deformation and failure modes; Evanston, IL, USA (18 Nov 1984).

Microcracking comes into play in many cases of brittle response of solids to applied load. Since the cracks are readily observable and their behavior is a subject of both common experience and extensive scientific investigation, it is natural that one would try to take explicit account of them in modeling deformation behavior. Several interesting problems arise in devising mathematical representations of crack distributions that are simple enough to use in continuum models and still apply to the entire range of observed behavior. In this note, two conventional mathematical representations of cracks with the behavior of three observed crack configurations are compared.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 4202009779, 9786, 9787, 9871, 9909, 10294, 10329, 10404

10193 (AD—905100/4) F.C.D.A. (Federal Civil Defense Administration) family shelter evaluation. Flynn, A.P. (Federal Civil Defense Administration, Washington, DC (USA)). Mar 1952. 86p. NTIS, PC A05/MF A01.

Report on Operation BUSTER; Project 9.1a.

Project 9.1 a BUSTER was designed to determine the effects of atomic explosions on small civil defense shelters for family use. Since limited participation in the program did not permit tests of all proposed shelter designs, data developed by Lehigh University Institute of Research served as a guide in selecting four types of shelters. They were: (1) covered-trench, (2) metal-arch, (3) wood-arch, and (4) basement lean-to. Twenty-nine simple structures were built along an arc 1200 ft. from the target point. Construction was varied without regard to protective values and only to obtain technical data for design purposes. These structures were subjected to Shots Baker, Charlie, and Dog.

10194 (AD-A—144137/7) Synthesis and characterization of superconducting electronic materials. Semiannual technical report 1 July-31 December 1983. Meservey, R.H.; Tedrow, P.M.; Orlando, T.P. (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). 15 Feb 1984. 9p. NTIS, PC A02/MF A01.

Films of VN as thin as 5 nm have been made by nitriding V films at high temperature. Tunnel junctions have been successfully made using both oxidized and nitrided amorphous Si barriers. Spin-polarized tunneling results show VN to have a small spin-orbit interaction, but larger than Al. Tunnel junctions have been successfully made on V_3Ga and spin-polarized tunneling shows spin splitting up to 20 Teslas. Structure and compositional analysis of the V_3Ga films has been carried out. We have successfully made high transition temperature Nb films as thin as 5 nm.

10195 (BNL-NUREG—29830) Analysis of critical experiments with Monte Carlo and ENDF/B-V data. Eisenhart, L.D.; Todosow, M. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 5p. (CONF-811103—32). NTIS, PC A02/MF A01 - GPO. File Number TI85003651.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

Calculations of critical experimental benchmarks are often used to qualify a specific computational approach for the solution of a class of problems whose characteristics are similar to those of the experimental configuration. Comparison of the calculated and experimental results helps to quantify the deviation of the calculated result from experimentally measured truth. This paper presents the results of Monte Carlo simulations with two state-of-the-art Monte Carlo programs, SAM-CE and RCP01, using ENDF/B-V nuclear data, for two critical experiments that are typical of configurations encountered in LWR fuel storage pools. The results are also compared to previously published results obtained during the validation of the SCALE system.

10196 (KEK—81-21, pp 17-23) **Replaceable liquid nitrogen piping.** Yasujima, Yasuo; Sato, Kiyoshi; Sato, Masataka; Hongo, Toshio (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Mar 1982. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780123. (CONF-8110341—).

From 4. symposium on machine work of scientific instruments; Oho, Ibaraki, Japan (24 Oct 1981).

This liquid nitrogen piping with total length of about 50 m was made and installed to supply the liquid nitrogen for heat insulating shield to three superconducting magnets for deflection and large super-conducting magnet for detection in the π-meson beam line used for high energy physics experiment in the National Laboratory for High Energy Physics. The points considered in the design and manufacture stages are reported. In order to minimize the consumption of liquid nitrogen during transport, vacuum heat insulation method was adopted. The construction period and cost were reduced by the standardization of the components, the improvement of welding works and the elimination of ineffective works. For simplifying the maintenance, spare parts are always prepared. The construction and the procedure of assembling of the liquid nitrogen piping are described. The piping is of double-walled construction, and its low temperature part was made of SUS 316L. The super-insulation by aluminum vacuum evaporation and active carbon were attached on the external surface of the internal pipe. The final leak test and the heating degassing were performed. The tests on evacuation, transport capacity and heat entry are reported. By making the internal pipe into smaller size, the piping may be more efficient.

10197 (LBL—17655) **Nb_3Sn dipole magnet reacted after winding.** Taylor, C.; Scanlan, R.; Peters, C.; Wolgast, R.; Gilbert, W.; Hassenzahl, W.; Meuser, R.; Rechen, J. (Lawrence Berkeley Lab., CA (USA)). Sep 1984. Contract AC03-76SF00098. 8p. (CONF-840937—22). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005166.

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

A 5 cm bore dia., 1-m-long dipole model magnet was constructed by winding un-reacted cable, followed by reaction and epoxy-impregnation. Experience and test results are described on the 1.7 mm dia. internal-tin wire, the eleven-strand flattened cable, fiberglass insulation, and construction of the magnet. Each half of the magnet has two double-pancake-type windings that were reacted in a single operation. The two double-pancakes were then separately vacuum impregnated after soldering the flexible Nb-Ti leads to the Nb_3Sn conductors. No iron flux return yoke was used. In initial tests a central field of 8.0 T was reached at 4.4 K. However, evidence from training behavior, and 1.8 K tests indicate that premature quenching, rather than critical current of the cable, limited the field intensity. The magnet was reassembled and more rigidly clamped; additional test results are reported.

10198 (NUREG/CR—3019) **Recommended welding criteria for use in the fabrication of shipping containers for radioactive materials.** Monroe, R.E.; Woo, H.H.; Sears, R.G. (Lawrence Livermore National Lab., CA (USA)). Mar 1984. Contract W-7405-ENG-48. 12p. (UCRL—53044). NTIS, PC A02/MF A01 - GPO. File Number TI84017027.

Welding and related operations are evaluated to assess the controls required to prevent weld-related failure of shipping containers used for transportation of radioactive materials. The report includes (1) recommended criteria for controlling welding as applied to shipping containers and (2) a discussion of modifications of the recommended industry Codes as applied to shipping containers. 13 references, 2 tables.

10199 (RFP—3597) **Rockwell International's Critical Mass Laboratory Program at the Rocky Flats Plant.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1984. Contract AC04-76DP03533. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003895.

A brief description is given of the RFP Critical Mass Laboratory, its primary mission, operation, and measurements underway. The criticality safety of the RFP operations is dependent on the ability of the Critical Mass Laboratory to continue its vigorous programs. (DLC)

10200 (RFP—3670) **Program at the Rocky Flats Critical Mass Laboratory.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1984. Contract AC04-76DP03533. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004983.

Purpose of the Critical Mass Laboratory is to provide direct plant support through experimental and calculational means to minimize the possibility of a nuclear criticality accident in the handling, processing, storage, and transportation of fissile material at RFP. Topics discussed in this talk are: organization of the CML; experimental capabilities of the CML; and programs of the CML.

10201 (RFP—3717) **Spring loaded hold-down for mounting HEPA filters at Rocky Flats.** Terada, K.; Rose, C.R.; Garcia, A.G. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1985]. Contract AC04-76DP03533. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005184.

The use of springs to maintain pressure on the gasket to form air tight seal between HEPA filters and their holders is described.

10202 (SVF—137) **Corrosion in chlorinated sea-water.** Dahl, L. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Apr 1983. 22p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750197.

Organic growth in sea-water cooling systems can cause loss of heat transfer and corrosion due to deposits or erosion-corrosion. Organic growth can be avoided by chemical or mechanical means, e.g., chlorination, which is mostly used. A literature study has been made including chlorination chemistry, analytical methods for control of construction materials as carbon steels, stainless steels, nickel alloys, copper alloys and titanium in chlorinated sea-water copper-nickel alloys with high nickel contents are more resistant than those with low nickel content and special brasses as admiralty or aluminium brass. Experiences from stainless steels are very limited, but probably ferritic, highly alloyed and stabilized steels are preferable compared with austenitic steels. Titanium is quite resistant, even if there are eroding conditions, such as use of Amertap systems. Recommendations for chlorination in connection with copper alloys are given.

10203 **Layered synthetic microstructure technology considerations for the extreme ultraviolet.** Keski-Kuha, R.A.M. (NASA Goddard Space Flight Center, Greenbelt, Maryland 20771). *Applied Optics;* **23**: No. 20, 3534-3537(15 Oct 1984). Contract AC02-76CH00016.

The performance of layered synthetic microstructures (LSMs) in the extreme ultraviolet (EUV), particularly in the 300-A spectral region, has been evaluated. Representative designs were analyzed, and experimental mirror coatings were produced. Pt-Si and Ir-Si combinations clearly demonstrated that the enhancement can be realized over a limited bandwidth of 75 A. Preliminary results for the Ir-Si combination on a diffraction grating indicate that LSMs enhance grating efficiencies in the EUV by a factor of $\sim$3.

10204 **Some psychrometric aspects of a hydraulic air compressor (HAC).** Li-Ting Chen; Rice, W. (Dept. of Mechanical and Energy Systems Engineering, Arizona State Univ., Tenipe, AZ 85281). *Journal of Energy Resources Technology;* **104**: No. 3, 274-276(Sep 1982).

In a hydraulic air compressor the air is surrounded by water during the compression process which is virtually isothermal. Depending on the state of the inlet air, the compressor water temperature, and the compression ratio, the compressed air may have higher or lower absolute humidity than that of the inlet air. Relationships between the two humidities are developed and criteria for "drying" to occur are presented.

4203 Lasers

10205 **(AD-A—144447/0) Gain-spread-excitation theorem.** Kroll, N.; Rosenbluth, M. (Mitre Corp., McLean, VA (USA)). May 1984. 52p. (JSR—82-110). NTIS, PC A04/MF A01.

This paper proposed an extension of the Madey gain-spread theorem to two-dimensional wigglers and shown it to be quite generally valid. It has the important consequence that an Free Electron Laser(FEL) wiggler which yields gain must at the same time generate either energy spread or transverse excitation. Furthermore it was found that in an FEL operating quasi linearly in a storage ring, that laser gain guarantees the production of entropy with every pass through the wiggler. Consequently the laser radiation generated is restricted to be some small fraction of the synchrotron radiation and our analysis suggests that this fraction is of the order of the fractional energy aperture. This leads us to the conclusion that the achievement of high efficiency steady stage storage ring operation in a quasi linear regime is not possible. Nonetheless, it appears that gain expanded wigglers may have superior linear gain as compared with conventional wigglers and thus prove to be useful for application in storage rings with large fractional energy aperture.

10206 **(AD-A—144481/9) High power millimeter wavelength coherent radiation sources. Scientific report 1 February 1983-31 January 1984.** Walsh, J.E. (Dartmouth Coll., Hanover, NH (USA). Dept. of Physics and Astronomy). 15 Jun 1984. 79p. NTIS, PC A05/MF A01.

During the reporting period, Cerenkov Maser resonators with a rectangular configuration were analyzed, constructed and experimentally tested. All of the previous work was based upon cylindrical resonators, a choice which was convenient because of the intrinsic symmetry of the beam transport and focussing. In many potential applications, however, an amplifier would be more useful than a oscillator and a structure which, coupled to a linearly-polarized field would then be far more convenient. It was for this purpose that the rectangular dielectric slab waveguide structures were analyzed and tested.

10207 **(AD-A—144824/0) Experimental properties of an inhomogeneously broadened He-Xe unstable ring laser. Final report October 1981-December 1983.** Liu, Y.M. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Jul 1984. 59p. (AFWL-TR—84-30). NTIS, PC A04/MF A01.

Although the ring resonator has been previously investigated in several ways, the unstable ring resonator with imhomogeneously broadened gain medium is not yet well understood. The objective of this thesis is to explore reverse mode suppression in an unstable ring resonator by using a helium-xenon (He-Xe) gas mixture which is inhomogeneously broadened. The optical feedback technique employing a suppressor mirror was used. Several aspects of the unstable ring resonator are discussed: the relative power levels in forward and reverse waves, with and without the suppressor mirror, with strong and weak couplings from reverse wave to forward wave; the near field and far field patterns; and the mode volume effect. The degree of suppression in the reverse wave and the degree of increase in the forward wave, when the suppressor mirror was in place, are also discussed.

10208 **(AD-A—145057/6) NRL (Naval Research Laboratory) FEL (Free Electron Laser) program. Final report 29 December 1982-29 June 1984.** (KM Sciences, Arlington, VA (USA)). 29 Jun 1984. 35p. NTIS, PC A03/MF A01.

The Naval Research Laboratory (NRL) Free Electron Laser (FEL) program proposed to use the NRL Electron Linear studies. Previous work by KM Sciences had concentrated on the evaluation of the upgrades needed on the entire facility to meet the needs of the FEL program. These had included injection electronics, injection hardware, accelerating structures, beam transport alignment, and the required additional deflection systems. The continuing work reported herein focuses on the design of a new injection system, beam quality evaluation, and on the design of an energy and phase analysis systems for the resultant electron beam. A computer ray-tracing program describing the interaction of the electron beam with the FEL wiggler structure will also be discussed.

10209 **(AD-A—145109/5) Free electron lasers. Final technical report 1 January-1 December 1983.** Colson, W.B. (California Univ., Santa Barbara (USA). Dept. of Physics). 1 Dec 1983. 11p. NTIS, PC A02/MF A01.

Further support of the LANL experiment and the strong-field synchrotron instability has used the periodic window for optical mode analysis. Using the LANL parameters current and magnetic field strength, the effect of the resonator or mode stability was examined. It was found that as much as 20% loss/pass was necessary for the FEL to run without sidebands. When the losses were dropped to 14% pass, a single sideband appeared in the untapered FEL planned at LANL. When the losses were lowered to 1% (as eventually planned), the optical field vacame chaotic and the FEL went broad band.

10210 **(N—84-33344) Quantum optics and photonics.** Ezekiel, S.; Mollow, B.R.; Kierstead, J.; Chanty, J.M.; Difillipo, D.; Hemmer, P.R.; Jain, S.H.; Meyer, R.E.; Peuse, B.W.; Ponikvar, D.R. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1984. 7p. NTIS, PC A12/MF A01.

In RLE program report No. 126, 41-47, N—84-33336 22-99.

Measurement of Fresnel-drag in moving media using a ring resonator techniques, observation of lineshape distortion by Raman induced focusing, the performance of a microwave clock based on a laser induced simulated Raman interaction, and a fiber ring resonator gyroscope are discussed.

10211 **(PB—84-231554) Chinese technology in the sector of lasers and quantum electronics.** Flytzanis, C. (Centre de Documentation de l'Armement (CEDOCAR), 75 - Paris (France). Direction des Recherches, Etudes et Techniques). 1984. 56p. (In French). NTIS, PC E04/MF E04.

China's efforts have been centered on experimental and technical approaches, to the detriment of any theoretical approach, intensifying coordination among different institutes. The multiplication of identical work was a result, which impression was reinforced by the emphasis placed on duplication of foreign materials. In spite of a shortage of means and technical levels both in electronics and mechanics, the teams manage to reproduce almost the entirety of laser technology and the necessary components for optical telecommunications. With time and experience, the performance and viability of these instruments will improve considerably and become competitive with those abroad.

10212 **(RFP—3644) Unique, time saving applications of the ion chromatograph in an industrial laboratory.** Miller, A.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 14 Dec 1984. Contract AC04-76DP03533. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004979.

Since the purchase of a Dionex 2120 Ion Chromatograph in April of 1982, the instrument has proven to be a valuable addition to the laboratory at Rocky Flats Plant. The technique has been applied to verifying composition and determining trace impurities for quality control of purchased chemicals. The comprehensive rapid identification of anions and cations has been made of surface corrosion residue of metals. Composition and concentration control of metal cleaning baths have been developed, where accuracy and turn around time are important. The use of the ion chromatograph has also been applied to metal plating baths for composition and impurities analyses. Other applications have been made to water leaches of solids and of special liquid samples.

10213 **(UCRL—91670) Advanced crystalline laser materials.** Krupke, W.F. (Lawrence Livermore National Lab., CA (USA)). 1984. Contract W-7405-ENG-48. 8p. (CONF-8410201—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003142.

From NASA workshop on tunable solid state lasers for remote sensing; Stanford, CA, USA (1 Oct 1984).

To guide the laser materials research and development effort, we have analyzed the scaling laws for zig-zag and flow-cooled disk amplifiers, defined materials figures of merit, and developed laser performance applications maps. Within this technical framework, we have embarked on an effort to synthesize, characterize, select, and develop new materials useful for a variety of robust laser applications.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 4204009541, 9545, 9580, 9907, 9928, 9941, 10049, 10235, 10236, 10237, 10240

10214 **(CONF-850219—1) Flow-induced vibrations of a circular cylinder due to turbulent internal flows.** Chung, H. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002766.

From Offshore mechanics and arctic engineering symposium; Dallas, TX, USA (17 Feb 1985).

Flow-induced vibration characteristics are experimentally investigated for a circular cylinder subjected to a turbulent internal flow. Analytical studies and modal analysis testing were also performed to investigate the free libration characteristics of the cylinder in air and in fluid. The obtained free vibration characteristics were used to aid interpretation of the flow-induced vibration test results. Test results show that the cylinder was excited by the turbulent axial flow and experienced a narrow-band random vibration consisting of many localized shell-modes. The RMS vibration amplitude was small. However, it monotonically increased with the flow rate.

10215 **(N—84-20528) Development and implementation of advanced diagnostic techniques.** Hess, C.F. (Spectron Development Labs., Inc., Costa Mesa, CA (USA)). Apr 1984. 7p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 23-29, N—84-20525 11-07.

Two techniques were identified which offer great potential in the measurement of sprays. The first is referred to as IMAX, and it consists of a nonintrusive pulse height analyzer. The second is referred to as Visibility/Intensity (V/I) and it performs a size measurement by examining the visibility and the pedestal intensity that the IMAX technique provides a larger dynamic range and higher accuracy than V/I. It also shows that the two-color IMAX concept provides a higher S/N primarily because of the high efficiency in spectrally separating the two signals. The size distribution of two kinds of sprays are reported. The first spray was produced by a Berglund-Liu droplet generator with dispersion air. The second spray was produced by a pressure nozzle.

10216 **(N—84-20529) Analysis and testing of a new method for drop size and velocity measurements using laser light scatter interferometry.** Bachalo, W.D. (Aerometrics, Inc., Mountain View, CA (USA)). Apr 1984. 15p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 31-45, N—84-20525 11-07.

Drop size and velocity can be measured simultaneously using an optical system which is the same as a laser Doppler velocimeter except that three detectors are located at selected spacings behind the receiver aperture. Drops passing through the intersection of the two beams scatter light which produces an interferrence fringe pattern. The temporal frequency of the fringe pattern is the Doppler difference frequency which is linearly proportional to the drop velocity while the spatial frequency is linearly related to the drop diameter. The spacing of the fringes is also dependent upon the light wavelength, beam intersection angle, drop refractive index (unless reflected light is measured), and the location of the receiver. The theoretical analysis was verified, signal phase processing methods were evaluated, and the effects of signal quality upon the measurements were investigated.

10217 **(N—84-20539) Advanced numerics for multi-dimensional fluid flow calculations.** Vanka, S.P. (Argonne National Lab., IL (USA)). Apr 1984. 4p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 99-102, N—84-20525 11-07.

In recent years, there has been a growing interest in the development and use of mathematical models for the simulation of fluid flow, heat transfer and combustion processes in engineering equipment. The equations representing the multi-dimensional transport of mass, momenta and species are numerically solved by finite-difference or finite-element techniques. However despite the multiude of differencing schemes and solution algorithms, and the advancement of computing power, the calculation of multi-dimensional flows, especially three-dimensional flows, remains a mammoth task. The following discussion is concerned with the author's recent work on the construction of accurate discretization schemes for the partial derivatives, and the efficient solution of the set of nonlinear algebraic equations resulting after discretization. The present work has been jointly supported by the Ramjet Engine Division of the Wright Patterson Air Force Base, Ohio, and the NASA Lewis Research Center.

10218 **(N—84-20543) Velocity visualization in gaseous flows.** Hanson, R.K.; Hiller, B.; Hassa, C.; Booman, R.A. (Stanford Univ., CA (USA)). Apr 1984. 7p. NTIS, PC A14/MF A01.

Techniques yielding simultaneous, multiple-point measurements of velocity in reacting or nonreacting flow fields have the potential to significantly impact basic and applied studies of fluid mechanics. This research program is aimed at investigating several candidate schemes which could provide such measurement capability. The concepts under study have in common the use of a laser source (to illuminate a column, a grid, a plane or a volume in the flow) and the collection of light at right angles (from Mie scattering, fluorescence, phosphorescence or chemiluminescence) using a multi-element solid-state camera (100 x 100 array of photodiodes). The work will include an overview and a status report of work in progress with particular emphasis on the method of Doppler-modulated absorption.

10219 **(N—84-20548) Turbulence characteristics of an axisymmetric reacting flow.** Gould, R.D.; Stevenson, W.H.; Thompson, H.D. (Purdue Univ., Lafayette, IN (USA)). Apr 1984. 10p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 189-198, N—84-20525 11-07.

Turbulent sudden expansion flows are of significant theoretical and practical importance. Such flows have been the subject of extensive analytical and experimental study for decades, but many issues are still unresolved. Detailed information on reacting sudden expansion flows is very limited, since suitable measurement techniques have only been available in recent years. The present study of reacting flow in an axisymmetric sudden expansion was initiated under NASA support in December 1983. It is an extension of a reacting flow program which has been carried out with Air Force support under Contract F33615-81-K-2003. Since the present effort has just begun, results are not yet available. Therefore a brief overview of results from the Air Force program will be presented to indicate the basis for the work to be carried out.

10220 **(N—84-20720) Design and application of two stage evaporative cooling systems.** Cumming, D.C.; Hawkins, D.M.; Hawkins, D.M. (South African Inst. of Refrigeration and Air Conditioning, Pretoria). 1983. 14p. NTIS, PC A14/MF A01.

In Frigair 1983: Papers, 14 p., N—84-20717 11-31.

The design and application of two stage evaporative systems were examined. Component selection, computer simulation, component and system performance are discussed. Application and actual operating performance results for two installations are presented.

10221 **(N—84-21826) Extremal-variational principle for unsteady thermal conduction applied to thermoelastic problems using finite elements.** Kaempf, B. (Ruhr-Univ., Bochum (Germany, F.R.)). Mar 1983. 134p. (MITT—35). Ruhr-Univ., Bochum, Germany.

Unsteady temperature field including a known heat source is described by an extremal-variational principle in the function space. Finite element method (FEM) programs for one and two dimensional bodies were developed. Examples were compared with known solutions and experimental results. The so determined temperature profile was applied to the principle of virtual work. Corresponding thermal stresses were calculated. An FEM program developed for this purpose was tested with single examples. Results demonstrate the validity of the theory. (ESA)

10222 **(N—84-21849) Measurement of fluid properties using rapid-double-exposure and time-average holographic interferometry.** Decker, A.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1984. 12p. (NASA-TM—83630; E—2067). NTIS, PC A02/MF A01.

The holographic recording of the time history of a flow feature in three dimensions is discussed. The use of diffuse illumination holographic interferometry or the three dimensional visualization of flow features such as shock waves and turbulent eddies is described. The double-exposure and time-average methods are compared using the characteristic function and the results from a flow simulator. A time history requires a large hologram recording rate. Results of holographic cinematography of the shock waves in a flutter cascade are presented as an example. Future directions of this effort, including the availability and development of suitable lasers, are discussed.

10223 **Droplet impacts upon liquid surfaces.** Ching, B.; Golay, M.W.; Johnson, T.J. (Massachusetts Inst. of Tech., Cambridge). *Science (Washington, D.C.);* **226**: 535-537(2 Nov 1984).

The absorption and rebounding of single droplets and streams of droplets (of diameter less than 1200 micrometers) impacting upon the surface of a deep liquid were examined experimentally. Conservation of mechanical energy and momentum were used to explain rebounding droplet interactions, and impaction criteria have been established regarding the absorption of droplet streams. Surface tension is the dominant mechanism governing the observed behavior. Single droplets were never observed to rebound.

10224 **Asymptotic analysis of radiative transfer problems.** Larsen, E.W.; Pomraning, G.C.; Badham, V.C. (Univ. of California, Los Angeles). *Journal of Quantitative Spectroscopy and Radiative Transfer;* **29**: No. 4, 285-310(1983).

The equations of radiative transfer are systematically analyzed by asymptotic methods. To lowest order, the classical equilibrium diffusion approximation is recovered. The next order analysis leads to the equilibrium diffusion differential equations and initial conditions, but with a boundary condition containing a linear extrapolation distance α. This quantity is related to the solution of a canonical halfspace problem and is computed by deriving an appropriate variational principle. For the case of no scattering, an exact Wiener-Hopf solution is available. The F/sub N/ solution technique is also applied to the problem of obtaining α with good results. Higher order aymptotic radiative transfer descriptions are discussed and, while not immediately constituting practical calculational techniques, do have implications for computing the parameters in the multiband treatment of the frequency variable.

10225 **Interfacial area and nucleation site density in boiling systems.** Kocamustafaogullari, G.; Ishii, M. (Univ. of Wisconsin, Milwaukee). *International Journal of Heat and Mass Transfer;* **26**: No. 9, 1377-1387(1983).

The number density, which is one of the most important parameters affecting the interfacial area concentration in the bubbly two-phase flow system, is formulated in terms of the differential transport equation. From this formulation it becomes apparent that the active nucleation site density on a heated channel surface is the key parameter in the prediction of the bubble number density. A constitutive relation for active nucleation site density is developed in pool boiling and extended to forced convective nucleate boiling. The active nucleation site densities predicted by this constitutive relation are in relatively good agreement with direct measurements available in the literature.

4205 Materials Testing

REFER ALSO TO CITATION(S) 4205010331, 10336

10226 **(CONF-8408133—2) NDE methods for green ceramics.** Kupperman, D.S.; Ellingson, W.A.; Berger, H. (Argonne National Lab., IL (USA)). Oct 1984. Contract W-31-109-ENG-38. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004019.

From Japan/US seminar on fundamentals of structural ceramics; Seattle, WA, USA (1 Aug 1984).

This paper describes a preliminary investigation of radiographic, ultrasonic, and nuclear magnetic resonance (NMR) imaging methods for the nondestructive evaluation of green (unfired) ceramics. Microradiography provides sharper images than ordinary radiographs, and very small defects can be detected. The application of microradiography to ceramics is reviewed, and preliminary experiments with a commercial microradiography unit are described. Computerized axial tomographic (CAT) imaging with x-rays provides images of cross sections of an object and thus eliminates unwanted detail (noise). CAT scanning provides for detection of flaws in the 10 to 100 μm range. Initial CAT-scanning results for green-state ceramics are presented. Conventional ultrasonic techniques are difficult to use in green ceramics because of their high attenuation, fragility, and couplant-absorbing properties. However, ultrasonic velocity and attenuation data are presented which provide useful information related to density variations and the elastic anisotropy of the green state. The NMR study suggests that areas of high porosity may be detectable if the binder is burned out and replaced with a hydrogen-rich dopant such as water.

10227 **(NE-FBA—83-18) Glass fiber reinforced plastic tubes for the transport of hot water at temperatures below 110 degreeC. Final report, stage 4.** Eriksson, P. (Naemnden foer Energiproduktionsforskning, Spanga (Sweden)). Mar 1983. 81p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750174.

This investigation deals with the length of life of tube materials and with different sorts of rubber. The lifetime of tubes made of glass fiber reinforced polyester is estimated to be 0.5 year at 100 degreeC, and considerably longer for epoxy tubes at 110 degreeC. Cracks have been located to couplings. The best qualities of rubber of EPDM type have a length of life of about 3 years, as determined by relaxation in water which contains oxygen and in air at 110 degreeC. The length of life can be increased five times by reducing the content of oxygen, dissolved in water to below 0.01 ppm.

10228 **(UCRL—91763) Numerical simulation of static and dynamic shadow patterns using an atomistic description of crack initiation and propagation.** Moran, B.; Hoover, W.G.; Norris, D.M. (Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA). Dept. of Applied Science; Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1984. Contract W-7405-ENG-48. 7p. (CONF-841203—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003226.

From 6. international conference on fracture; New Delhi, India (4 Dec 1984).

In this paper we model crack propagation from an atomistic point of view. We seek to understand the phenomenology of crack propagation in a decreasing stress field. Our objective is to better understand the interpretations and implications of optical measurements (Kalthoff, Beinert, and Winkler, 1977a) of stress intensities. Our computational method is to use the simplest interatomic potential which captures the important features of real interactions and structure of cracks from a discrete point of view. In our atomistic approach the fracture criterion is not independently specified but rather follows, along with all other macroscopic constitutive quantities, from the interparticle forces. We developed a model to esti-

mate the average strength of the stress singularity from a direct simulation of the shadow pattern using the strain distribution around the crack tip. We applied this model to the steady state propagation of a crack in a finite strip and obtained good agreement with Nilsson's (1972, 1973) corresponding continuum solution.

4206 Safety Engineering

10229 (TRITA-HFL—0037) Critical review of present fracture mechanics. Design concepts for pipelines. Thoren, S. (Royal Inst. of Tech., Stockholm (Sweden)). [1984]. 71p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85750172.

A failure of a major gas transmission pipeline could result in significant economic losses as well as severe personal safety hazards. Thus the desire is to have a safe but optimal design. It is therefore of great interest to develop tools for accurate prediction of possible failure events. In this study, proposed treatments of the failure initiation and failure propagation events are described and discussed. The failure initiation event is fairly well understood for through cracks, but the treatment of part through cracks is not adequate. Possible stable crack growth is one aspect that needs more attention. The proposed treatments of propagating ductile cracks are often over-simplified. In the discussed models the large axial deformations are neglected (one exeption only) and the basic assumptions regarding material fracture propagation resistance can be disputed. This study points to the need for further study of both the failure initiation and the failure propagation events.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 42080010046

10230 (N—84-29330) Plasmon device design: conversion from surface to junction plasmons with grating-couplers. Anderson, L.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 1p. NTIS, PC A12/MF A01.

In Space Photovoltaic Research and Technology, 1983, 144, N—84-29307 19-44.

Scaling calculations and numerical studies are used to show that grating couplers provide effective energy transfer between surface plasmons and slower modes localized in the tunnel diodes. Within first order perturbation theory in grating amplitude, 90% efficiency energy transfer occurs within micrometers for realistic structures and materials parameters. Scaling laws are derived. Seventy to 90% of the electromagnetic field energy is concentrated in the oxide layer of an MOM diode after the energy is distributed by longer range modes that have less than 0.1% overlap with the tunneling region. The mode conversion allows the requirements separation for energy transport and power production by inelastic tunneling.

10231 (N—84-29331) Interactions between volume and surface EM waves in layered structures. Ushioda, S. (California Univ., Irvine (USA)). 1984. 1p. NTIS, PC A12/MF A01.

In NASA, Lewis Resarch Center, Space Photovoltaic Research and Technology, 1983, 156, N—84-29307 19-44.

Using light scattering spectroscopy, the interaction of Surface Plasmon Polariton SPP in silver films on a glass substrate is with the incident radiation and with optical phonons of an external medium in contact with the film. The mean free path and the field strength of SPP are determined. The same SPP plays an important role in light emitting tunnel junctions (LETJ) in which an electrical current is converted into Volume Electromagnetic Wave VEW. The efficiency of light emission from LETJ through a prism coupler rather than through surface roughness is discussed. The coupling between phonon surface polaritons (PhSP) and optical guided waves (OGW) in thin films of GaP is also examined.

10232 (N—84-33353) Submicron structures technology and research. Smith, H.I.; Hawryluk, A.M.; Horwitz, C.M.; Meingailis, J.; Thompson, C.V.; Chen, D.P.; Yonehara, T.; Anderson, E.H.; Atwater, H.A.; Chou, S.Y. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1984. 9p. NTIS, PC A12/MF A01.

In RLE program report No. 126, 85-93, N—84-33336 22-95.

The following research projects are described briefly: microfabrication, electronic conduction in ultra-narrow silicon inversion layers, MOS structures, field effect transistors, graphoepitaxy, zone melting recrystallization, transmission gratings, and diffraction gratings.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 4209009642

4210 Combustion Systems

REFER ALSO TO CITATION(S) 4210009684

10233 (EPRI-AP—3753) Fuels- and combustion-related problems of oil- and gas-fired utility boilers: an EPRI workshop. Sanders, C.F.; McDonald, B.L. (Energy Systems Associates, Tustin, CA (USA)). Oct 1984. 44p. (CONF-8311224—). Research Reports Center, Box 50490 Palo Alto, CA 94303 $8.50. File Number TI85920085.

From EPRI workshop on fuels-and combustion-related problems of oil-and gas-fired utility boilers; Atlanta, GA, USA (30 Nov 1983).

A workshop was held in Atlanta, Georgia on November 30 and December 1, 1983 for fuels, operating, and engineering personnel from sixteen different utilities to discuss Fuels and Combustion Related Problems of Oil- and Gas-Fired Utility Boilers. The primary objective of the workshop was to utilize the experiences of utility participants to identify the technical problem areas in which EPRI might best direct its research and development efforts to improve gas- and oil-fired steam generating systems performance. The nineteen utility participants brought many problems to the two days of discussions. A number of problems were associated with two general areas of concern - changing fuel oil quality resulting from trends in refinery practices, current and future; and cycling boiler operations resulting from changes in electrical load distribution. The utilities expressed a desire for fuel oil specifications and tests adequate for anticipating operating and economic impacts of changing fuels. Similarly, they wanted better knowledge of the impacts of cycling operations, and how to extend the useful lives of boiler systems and components. 5 tables.

10234 (N—84-20544) Investigations of flowfields found in typical combustor geometries. Lilley, D.G. (Oklahoma State Univ., Stillwater (USA)). Apr 1984. 13p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 139-151, N—84-20525 11-07.

Studies are concerned with experimental and theoretical research on 2-D axisymmetric geometries under low speed, nonreacting, turbulent, swirling flow conditions. The flow enters the test section and proceeds into a larger chamber (the linear expansion ratio D/d 2, 1.5 and 1) via a sudden or gradual expansion (side wall angle alpha 90 and 45 degrees). A weak or strong nozzle (of area ratio A/a 2 and 4) may be positioned downstream at x/D 2 to form a contraction exit to the test section. Inlet swirl vanes are adjustable to a variety of vane angles with values of theta 0, 38, 45, 60 and 70 degrees being emphasized. The objective is to determine the effect of these parameters on isothermal flow field patterns, time mean velocities and turbulence quantities, and to establish an improved simulation in the form of a computer prediction code equipped with a suitable turbulence model. The goal of the on going research is to perform experiments and complementary computations with the idea of doing the necessary type of research that will yield improved calculation capability. This involves performing experiments where time mean turbulence quantities are measured and taking input conditions and running an existing prediction

code for a variety of test cases so as to compare predictions against experiment.

10235 **(N—84-20546) Free stream turbulence and density ratio effects on the interaction region of a jet in a cross flow.** Wark, C.E.; Foss, J.F. (Michigan State Univ., East Lansing (USA)). Apr 1984. 12p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 163-174, N—84-20525 11-07.

Jets of low temperature air are introduced into the aft sections of gas turbine combustors for the purpose of cooling the high temperature gases and quenching the combustion reactions. Research studies, motivated by this complex flow field, have been executed by introducing a heated jet into the cross stream of a wind tunnel. The investigation by Kamotani and Greber stands as a prime example of such investigations and it serves as the principal reference for the present study. The low disturbance level of the cross stream, in their study and in similar research investigations, is compatible with an interest in identifying the basic features of this flow field. The influence of the prototypes strongly disturbed cross flow is not, however, made apparent in these prior investigations.

10236 **(N—84-20547) Modeling of dilution jet flowfields.** Holdeman, J.D.; Srinivasan, R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1984. 13p. NTIS, PC A14/MF A01.

In Combustion fundamentals research, 175-187, N—84-20525 11-07.

The present paper will compare temperature field measurements from selected cases in these investigations with distributions calculated with an empirical model based on assumed vertical profile similarity and superposition and with a 3-D elliptic code using a standard K-E turbulence model. The results will show the capability (or lack thereof) of the models to predict the effects of the principle flow and geometric variables.

10237 **(N—84-20550) Characteristics of inhomogeneous jets in confined swirling air flows.** So, R.M.C.; Ahmed, S.A. (Arizona State Univ., Tempe (USA)). Apr 1984. 14p. NTIS, PC A14/MF A01.

In NASA. Lewis Research Center, combustion fundamentals research, 223-236, N—84-20525 11-07.

An experimental program to study the characteristics of inhomogeneous jets in confined swirling flows to obtain detailed and accurate data for the evaluation and improvement of turbulent transport modeling for combustor flows is discussed. The work was also motivated by the need to investigate and quantify the influence of confinement and swirl on the characteristics of inhomogeneous jets. The flow facility was constructed in a simple way which allows easy interchange of different swirlers and the freedom to vary the jet Reynolds number. The velocity measurements were taken with a one color, one component DISA Model 55L laser-Doppler anemometer employing the forward scatter mode. Standard statistical methods are used to evaluate the various moments of the signals to give the flow characteristics. The present work was directed at the understanding of the velocity field. Therefore, only velocity and turbulence data of the axial and circumferential components are reported for inhomogeneous jets in confined swirling air flows.

10238 **(N—84-20560) Transient flow combustion.** Tacina, R.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1984. 5p. NTIS, PC A14/MF A01.

In Combustion fundamentals research, 309-310, N—84-20525 11-07.

Non-steady combustion problems can result from engine sources such as accelerations, decelerations, nozzle adjustments, augmentor ignition, and air perturbations into and out of the compressor. Also non-steady combustion can be generated internally from combustion instability or self-induced oscillations. A premixed-prevaporized combustor would be particularly sensitive to flow transients because of its susceptability to flashback-autoignition and blowout. An experimental program, the Transient Flow Combustion Study is in progress to study the effects of air and fuel flow transients on a premixed-prevaporized combustor. Preliminary tests performed at an inlet air temperature of 600 K, a reference velocity of 30 m/s, and a pressure of 700 kPa. The airflow was reduced to 1/3 of its original value in a 40 ms ramp before flashback occurred. Ramping the airflow up has shown that blowout is more sensitive than flashback to flow transients. Blowout occurred with a 25 percent increase in airflow (at a constant fuel-air ratio) in a 20 ms ramp. Combustion resonance was found at some conditions and may be important in determining the effects of flow transients.

10239 **(N—84-20561) Combustor flame flashback.** Proctor, M.P.; Anderson, D.N. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1984. 2p. NTIS, PC A14/MF A01.

In Combustion fundamentals research, 311-312, N—84-20525 11-07.

Flashback, a problem that occurs in premixed-prevaporized combustors, is the upstream propagation of the flame from the combustor into the premixing tubes. Not only does flashback change the combustion process from premixed burning to diffusion burning, thus creating more pollutants, but it also inflicts considerable damage to the fuel injector, premixing tube and other equipment upstream. The conditions at which flashback occurs in steady burning and the mechanism that causes flashback in both steady and transient flow are studied. The equivalence ratio at which flashback occurs is being measured for inlet temperatures of 600-950 K, premixer wall temperatures of 450-1050 K and premixer velocities of 40-80 ft/s. These data are presented.

10240 **(N—84-21830) Laser Doppler velocimetry measurements of mean velocity and turbulent stress tensor components in a free isothermal swirling jet.** Sislian, J.P.; Cusworth, R.A. (Toronto Univ., Ontario (Canada)). Mar 1984. 119p. (UTIAS—281). NTIS, PC A06/MF A01.

Measured values of three components of mean velocity and the six components of the turbulent stress tensor are reported in free, isothermal, axisymmetric, swirling jet flows representative of combustor swirl flows. Data was provided against which results of numerical prediction procedures are compared, and quantitative information on the behavior of all turbulent stresses and their correlation to spatial distribution of mean velocity gradients, with a view on improving our understanding of relevant transport processes and on guiding turbulence modelling and prediction efforts of such flows. From measured distributions of the mean velocities and various shear stress components, effective viscosity distributions are derived. Significant radial variation of effective viscosity is shown together with considerable anisotropy of turbulence. Finally, experimental data indicate a strong dependence of the turbulent stresses on the local strain of the mean flow, which suggests that an eddy viscosity type turbulence model rather than a Reynolds stress model is acceptable for the prediction of such flows.

10241 **(NP—5750144) Aerodynamics in fire tube boilers.** Gundtoft, S.; Fremmelev, K.; Kirk Thoegersen, L. (Jydsk Teknologisk Institut, Aarhus (Denmark)). 1984. 178p. (In Danish). NTIS (US Sales Only), PC A09/MF A01. File Number DE85750144.

Model experiments were carried out with flow in a so-called "cold-model" of an existing packaged fire tube boiler. The model experiments have particularly aimed at establishing the influence of the thermal buoyancy on the flow conditions. A model has been made of the thermal buoyancy in turbulent diffision flames, and the model has been assessed by comparison with experiments in the full-scale boiler. Moreover, experiments have been made with turbulence-provoking insertions in the model. The work with the mathematical flow model was limited to an isothermal flow. The buoyancy experiments in the model showed that the thermal buoyancy in the flame may result in a temperature stratification in the rear part of the furnace tube and the first bank of fire tube, especially at a low capacity. Flue gas mixing insertions may equalize the thermal stratification, but only after the insertion reckoned in the direction of flow. The front flow in and around the flame is not influenced by insertions placed at the rear of the furnace tube. The model experiments show that a strong asymmetry may arise in the recirculation picture as a consequence of buoyancy on the flame volume - especially at low load. Insertions placed at the rear of the furnace tube are hardly of any importance in this connection.

10242 **(SVF—143) Technique - and market inventory of todays fluidized bed manufacturers in Scandinavia.** Karnik, C. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Oct 1983. 69p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750203.

This report is an inventory about fluidized bed development and manufacturing in Scandinavia. In the inventory the different companies' techniques, reference plants, sizes, fuel demands, etc., are presented and compared. The inventory shows that today there are nine companies in Scandinavia developing and manufacturing fluidized beds. Most of them working with conventional fluidized beds, some with circulating beds and others with both kinds. The fluidized beds are manufactured for steam or for hot water production in sizes up to 150 MW. In these fluidized beds, fuels as oil, coal, peat, wood waste and other solid fuels can be combusted. But there are certain demands on fuel-preparation as maximum sizes, dryness, etc. The demands are for achieving a good combustion and because of limitations in the fuel feeding system. The total efficiency for circulating fluidized beds is about 90 percent and a few percent less for conventional fluidized beds.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 4240009489, 9490, 9491, 9492, 9493, 9494, 9496

10243 **(DOE/ER/10386—T2) Particle deposition in granular media. Annual progress report.** Tien, C. (Syracuse Univ., NY (USA). Dept. of Chemical Engineering and Materials Science). 1984. Contract AC02-79ER10386. 139p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85005204.

The ultimate objective of the work reported is to develop a quantitative understanding of the various phenomena associated with aerosol filtration in granular media. Topics of investigation include: the correlation of the initial collection efficiency; a comparative study of methods for interpreting and evaluating experimental data; the effect of deposition on filter performance; methods for calculating aerosol filtration in fluidized filters; in situ observation of filtration in a two-dimensional model filter; and filtration in magnetically stabilized fluidized filters. (LEW)

4250 Power Cycles

10244 **(DTH-LFK—F67-01) Thermal properties of mixtures of halogenated refrigerants R12/R114.** Pedersen, P.H. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Koeleteknik). Mar 1982. 67p. (In Danish). NTIS (US Sales Only), PC A04. File Number DE85750141.

Methods for calculating thermodynamic and thermophysical properties of non-azeotropic mixtures of halogenated refrigerants are described. Martin-Hou equations of state are used for the pure substances, and ideal mixture laws are used for the mixtures. Computer models for R12/R114-mixtures have been developed, and log P-h-diagrams for different concentrations of these mixtures are presented.

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 43010010336, 10389

10245 **(HMI-B—411, pp 74-77) SNQ thermal neutron source DIANE and its experimental options.** Alefeld, B.; Bauer, G.S.; Conrad, H.; Stiller, H.H. 1984. Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). (CONF-840874—).

From Symposium on neutron scattering; Berlin, F.R. Germany (9 Aug 1984).

Published in summary form only.

10246 **(INS-NUMA—42, pp 123-128) Design consideration on the synchrotron ultrahigh vacuum system.** Tsujikawa, H.; Chida, K.; Mizobuchi, A. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study); Miyahara, A. Sep 1982. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780063. (CONF-8112108—Exc.).

From Workshop on accelerator in NUMATRON; Tanashi, Tokyo, Japan (8 Dec 1981).

Ultrahigh vacuum production for the high-energy heavy-ion accelerator poses special problems concerning beam-gas molecule and beam-wall interactions. In this paper, summary of the TARN ultrahigh vacuum system and design criteria of the synchrotron ultrahigh vacuum system are presented. On-beam pressure of 4×10^{-11} Torr is achieved in the TARN ultrahigh vacuum system, of which experiences through the construction and the operation are described and discussed. With emphasis on the application of newly developed technique in the fabrication of vacuum chamber and ultrahigh vacuum pump for the synchrotron ultrahigh vacuum system.

10247 (INS-NUMA—42, pp 131-133) **Low level RF electronics for the synchrotron.** Watanabe, Shin-ichi (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1982. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780063. (CONF-8112108—Exc.).

From Workshop on accelerator in NUMATRON; Tanashi, Tokyo, Japan (8 Dec 1981).

10248 (INS-NUMA—42, pp 149-152) **Interface for the computer control system.** Takanaka, Masao (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1982. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780063. (CONF-8112108—Exc.).

From Workshop on accelerator in NUMATRON; Tanashi, Tokyo, Japan (8 Dec 1981).

10249 (INS-NUMA—42, pp 153-155) **Proposal of the accelerator control system for NUMATRON.** Omata, Kazuo; Chiba, Kurazo; Watanabe, Shinichi; Takanaka, Masao (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1982. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780063. (CONF-8112108—Exc.).

From Workshop on accelerator in NUMATRON; Tanashi, Tokyo, Japan (8 Dec 1981).

10250 **(LBL—18403) Two-beam accelerator.** Selph, F.B. (Lawrence Berkeley Lab., CA (USA)). Sep 1984. Contract AC03-76SF00098. 24p. (CONF-8307126—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004662.

From 3. annual summer school on high energy accelerators; Upton, NY, USA (6 Jul 1983).

In the two-beam accelerator (TBA) concept, an electron linear accelerator structure is established in which two beams propagate. One is an intense low energy beam that is made to undergo free electron lasing to produce microwaves. These microwaves are then coupled to another part of the structure where they act to produce a high longitudinal electric gradient that is used to accelerate a second relatively low intensity electron beam to very high energies. The TBA was originally suggested by Sessler as a possible means for economically achieving linear collider energies of 100 GeV and above. Although still in a conceptual stage, the TBA is an inherently plausible concept that combines the free electron laser (FEL) with several well-known technologies - high current induction linacs, microwave waveguides, and traveling-wave linac structures - in a novel and interesting way. Two characteristics of the TBA that make it a particularly suitable candidate for achieving high energies are its ability to operate at higher frequencies than typical present-day linacs (say 30 GHz as compared with 3 GHz), and to be an efficient means for delivering power to a hitherto unattainable high-gradient structure (say 250 MV/m) that the higher frequency makes possible. These high accelerating gradients will permit much shorter linac structures for a given energy.

10251 (SLAC-PUB—3433) High field rf superconductivity: to pulse or not to pulse. Campisi, I.E. (Stanford Linear Accelerator Center, CA (USA)). Oct 1984. Contract AC03-76SF00515. 8p. (CONF-840937—25). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004381.

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

Experimental data on the behavior of superconductors under the application of rf fields of amplitude comparable to their critical fields are sporadic and not always consistent. In many cases the field level at which breakdown in superconducting rf cavities should be expected has not been clearly established. Tests conducted with very short ($\sim$ 1 μs) rf pulses indicate that in this mode of operation fields close to the critical values can be consistently reached in superconducting cavities without breakdown. The advantages and disadvantages of the pulsed method are discussed compared to those of the more standard continuous wave (cw) systems. 60 references.

4302 Beam Dynamics, Field Calculations, And Ion Optics

10252 (AD-A—144525/3) Investigation of ion beam production and acceleration using linear electron beams and a pulse powered plasma focus. Final progress report 1 April 1983-31 March 1984. (Maryland Univ., College Park (USA). Dept. of Electrical Engineering). Mar 1984. 73p. NTIS, PC A04/MF A01.

An intense relativistic electron beam cannot propagate in a metal drift tube when the current exceeds the space charge limit. Very high charge density and electric field gradients (100 to 1000 MV/m) develop at the beam front and the electrons are reflected. When a neutral gas or a plasma is present, collective acceleration of positive ions occur, and the resulting charge neutralization enables the beam to propagate. Experimental results, theoretical understanding, and schemes to achieve high ion energies by external control of the beams front velocity will be reviewed.

10253 (ANL/PHY—84-2, pp 1-14) ATLAS beam properties: some implications for target making. Pardo, R. (Argonne National Lab., IL). 1983. NTIS, PC A12/MF A01. File Number DE84017599. (CONF-8309127—). Contract W-31-109-ENG-38.

From International Nuclear Target Development Society workshop; Argonne, IL, USA (7 Sep 1983).

The expansion of the tandem-linac booster into the Argonne Tandem-Linac Accelerator System, ATLAS, is approximately 40% complete. When completed, the facility will provide beams of heavy ions from lithium to tin with energies eventually, up to 25 MeV/amu. The existing facility continues to provide beams for the experimental program in nuclear and atomic physics during the construction phase. The booster system is capable of accelerating ions as heavy as selenium, providing beam energies of 10 MeV/amu for the lighter ions. The good beam quality provided by the linac means that multiple scattering, energy straggling, and target inhomogenieties are major factors in the resolution attainable in experiments. The beam properties that can be expected from ATLAS will be discussed and the present state of high resolution experiments will be reported.

10254 (BNL—35438) Beam loss due to the aperture limitation resulting from intrabeam scattering. Lee, S.Y. (Brookhaven National Lab., Upton, NY (USA)). 12 Sep 1984. Contract AC02-76CH00016. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005138.

RHIC Technical Note No. 5.

Diffusion equation is used to evaluate the beam loss in the presence of aperture limitation resulting from the intrabeam scattering. We discuss the effect of different boundary conditions. Satisfactory beam intensity can be maintained within the proposed RHIC operation time.

10255 (BONN-IR—81-31) Acceleration of polarized electrons in the Bonn synchrotron and the planned stretcher ring ELSA. Brefeld, W. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). Oct 1981. 75p. (In German). Bonn Univ. (Germany, F.R.). Physikalisches Inst.

In the last year at the synchrotron polarized electrons were successfully accelerated. For this the polarization vector in the transfer channel between source and LINAC was rotated in such a way that the electrons can be injected into the accelerator with the necessary vertical polarization. It was shown that the degree of polarization of the electrons after passing of the imperfection resonances at 0.441 GeV, 0.881 GeV, 1.322 GeV, and 1.763 GeV and the intrinsic resonance at 1.498 GeV remained conserved at a high degree also without additional procedures. Although it is desirable to reduce the present depolarization. First attempts for overcoming the second resonance were performed. The results indicate that for this a system of two pulse dipoles doesn't suffice. For the answer of this question however a much more intensive polarized source is needed. At ELSA the working with polarized electrons seems to be possible in the whole energy range if it succeeds to circumvent the position of the intrinsic resonance dependent from the working point. Though the imperfection resonances at 2.203 GeV, 2.644 GeV, and 3.085 GeV can depolarize the electrons much more strongly because of the relatively slow passing through the resonances an overcoming with pulse dipoles should by possible. Because of the large resonance time-distances the dipoles have much more time than in the synchrotron to reach the required value steadily.

10256 (DOE/ER/10569—T3) Collective acceleration of ions using high current relativistic electron beams. (Cornell Univ., Ithaca, NY (USA)). [1985]. Contract AC02-80ER10569. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004889.

Ion acceleration has been obtained experimentally in the beat wave configuration, wave acceleration demonstrated in the converging guide geometry, and strong electric fields have been obtained and measured in the waves. The simulation effort in the Cornell theory program has proceeded to the point where satisfactory wave propagation has been throughout the converging guide, non linear wave propagation effects have been detected and studied, and a design of a converging guide assembly completed with acceleration of test ions. Numerical values of the wave phase velocities obtained match, or are lower than those found experimentally under comparable conditions. The simulation electric fields agree to within a factor of two with those measured experimentally. We have also identified a variety of new problems which require further study. These include the observation of fast waves in the beam and also, in the long pulse ($\sim$ 0.5 μsec) system, the onset of backward wave oscillations. The reflection of waves from the end of the wave growth structure has been observed recently by the MRC group who are working on design approaches to minimizing this effect. We review the different aspects of the Cornell theory and experiment program.

10257 (SLAC-PUB—3453) Design of a matched fast kicker system. Bulos, F.; Odian, A. (Stanford Linear Accelerator Center, CA (USA)). Sep 1984. Contract AC03-76SF00515. 13p. (SLAC-CN—279). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004890.

In designing fast ferrite-kickers: the pulser rise time must be as fast as possible; the ferrite must have good high frequency response to avoid pulse deterioration on travelling the magnet length; and a flat top is possible only when E.P.W. $>$ t(rise) + t(transit) as defined previously. The loss in the ferrite is proportional to tan $\delta/\mu = 1/\mu Q$; the μQ product must remain large up to frequencies $>$ 25 MH. The volume of the ferrite should be kept as small as practical. The capacitively loaded design is a simple method effective in reducing the ferrite volume. The capacitively loaded Blumlein is a suitable pulser for pulse lengths in the range 100 $\rightarrow$ 500 ns. It is well shielded and is capable of giving an adequately fast rise time and is fairly compact in comparison to the unloaded line. There are advantages and disadvantages to the loaded magnet design which

should be carefully considered for each application individually; they are not intuitively obvious.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 43030010253, 10310, 10510, 10513

10258 (ANL/HEP-CP—84-85) **Computing needs of the superconducting super collider.** Diebold, R. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 6p. (CONF-841007—36). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004016.

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

Following a brief description of the SSC, the computing needs are discussed for both the accelerator design and the experimentation. The computing power required is considerably beyond that being used at present facilities, and parallel processing is expected to play an important role in supplying these needs.

10259 (ANL/PHY—84-2, pp 15-43) **Special aspects on nuclear targets for high-energy heavy-ion accelerator experiments.** Folger, H.; Hartmann, W.; Klemm, J.; Thalheimer, W. (Gesellschaft fuer Schwerionenforschung, Darmstadt, West Germany). 1983. NTIS, PC A12/MF A01. File Number DE84017599. (CONF-8309127—).

From International Nuclear Target Development Society workshop; Argonne, IL, USA (7 Sep 1983).

Important facts about the GSI UNILAC accelerator are reviewed under the special aspects of target and stripper foil applications including general range considerations as seen after the upgrading of the machine to an energy of 20 MeV/u for all ions up to uranium. Current work and recent developments in target preparations at GSI are also reported, divided into four main groups of preparation procedures with sufficient overlap: cold rollings, carbon sublimation-condensations, focused heavy-ion sputter deposition, and the wide field of high-vacuum evaporation-condensations. Among others, a Ca reduction-distillation procedure is described, a new assembly is shown for sublimation-condensations of uniform C layers of 0.1 to 0.76 mg/cm^2 area densities. A selection of only a few applications of targets at the UNILAC can be given. Improved actinide targets are discussed, in-beam measurements of properties of targets on rotating wheels are explained, and a large-area target wheel with a circumference of nearly one meter is shown. SEM micrographs of damaged targets are given and explained.

10260 (ANL/PHY—84-2, pp 109-118) **Economical preparation of extremely homogeneous nuclear accelerator targets.** Maier, H.J. (Universitaet Munchen, Garching, West Germany). 1983. NTIS, PC A12/MF A01. File Number DE84017599. (CONF-8309127—).

From International Nuclear Target Development Society workshop; Argonne, IL, USA (7 Sep 1983).

Techniques for target preparation with a minimum consumption of isotopic material are described. The rotating substrate method, which generates extremely homogeneous targets, is discussed in some detail.

10261 (ANL/PHY—84-2, pp 153-162) **Computer controlled target storage system.** Nardi, B.G.; Worthington, J.N. (Argonne National Lab., IL). 1983. NTIS, PC A12/MF A01. File Number DE84017599. (CONF-8309127—). Contract W-31-109-ENG-38.

From International Nuclear Target Development Society workshop; Argonne, IL, USA (7 Sep 1983).

Hygroscopic or readily oxidizing targets need an appropriate and secure storage system. This is a description of a computer controlled target storage facility at ANL. The facility provides protection against vacuum failures and disruption of utilities.

10262 (ANL/PHY—84-2, pp 207-212) **Preparation of $^{235}UIr_2$ targets for use in g-factor measurements of fission isomers.** Alonso-Arias, C.; Dafni, E.; Rafailovich, M.H.; Riel, W.D.; Schatz, G.; Sprouse, G.D.; Vajda, S.; Zhu, S.Y. (State Univ. of New York, Stony Brook). 1983. NTIS, PC A12/MF A01. File Number DE84017599. (CONF-8309127—).

From International Nuclear Target Development Society workshop; Argonne, IL, USA (7 Sep 1983).

The cubic, nonparamagnetic alloy, $^{235}UIr_2$, was found to be a good host for the preservation of nuclear alignment in the g-factor measurement of the tau = 122(10) ns fission isomer of ^{237}Pu. This paper discusses, in detail, the preparation of the thin-film targets used in this measurement. These techniques were found to apply to other similar actinide alloys such as $NpRu_2$.

10263 (ANL/PHY—84-2, pp 213-214) **Progressively better techniques for the conversion of ^{41}KCl to ^{41}KOH.** Lozowski, W.R.; Krsek, J.A. (Indiana Univ. Cyclotron Facility, Bloomington). 1983. NTIS, PC A12/MF A01. File Number DE84017599. (CONF-8309127—).

From International Nuclear Target Development Society workshop; Argonne, IL, USA (7 Sep 1983).

After much effort to convert KCl to chlorine-free KOH by forming a mercury/potassium amalgam, this pursuit was abandoned in favor of a simple electrochemical cell in which silver foil was used as a sacrificial anode. Recently, we have acquired greater knowledge of the use of exchange resins and have, therefore, joined the mainstream.

10264 (ANL/PHY—84-2, pp 215-218) **Thoughts on solid targets for the IUCF storage and cooler ring.** Lozowski, W.R. (Indiana Univ. Cyclotron Facility, Bloomington). 1983. NTIS, PC A12/MF A01. File Number DE84017599. (CONF-8309127—).

From International Nuclear Target Development Society workshop; Argonne, IL, USA (7 Sep 1983).

For reasons to be described, practically all efforts to produce targets for beam storage and cooler rings are concerned with gas jet and vapor targets. This presentation will consider some promising possibilities for solid targets which must be extremely thin and yet survive in an unusual environment.

10265 (ANL/PHY—84-2, pp 219-226) **Role of the nuclear physics target laboratory in the new Chalk River Heavy Ion Facility.** Gallant, J.L.; Dmytrenko, P. (Chalk River Nuclear Laboratories, Ontario). 1983. NTIS, PC A12/MF A01. File Number DE84017599. (CONF-8309127—).

From International Nuclear Target Development Society workshop; Argonne, IL, USA (7 Sep 1983).

The new Chalk River Heavy Ion Facility will consist of a 13-MV MP Tandem Accelerator injecting into a K=520 (ME/q^2) superconducting cyclotron. Physics research will be carried out in such fields as the study of nuclei far from β stability, heavy ion reactions, study of nuclei with very high spin, atomic physics, etc. The laboratory will supply not only targets needed for the experiments, but also the large quantity of carbon stripper foils for the cyclotron and the large polypropylene windows needed for various detectors and counters. It will supply such materials as carbon-14 and tritium targets to other laboratories on a limited basis.

10266 (ANL/PHY—84-2, pp 231-234) **Thin self-supporting isotopic Dy, Er, Gd and Yb targets for charged particle spectroscopy.** Yaraskavitch, D.J.; Peng, Y.K. (McMaster Univ., Hamilton, Ontario). 1983. NTIS, PC A12/MF A01. File Number DE84017599. (CONF-8309127—).

From International Nuclear Target Development Society workshop; Argonne, IL, USA (7 Sep 1983).

A technique is described for the production of 100 to 300 μg/cm^2 self-supporting isotopic Dy, Er, Gd and Yb targets. The targets are prepared by a simultaneous metallothermic reduction of the oxide and vapor deposition onto a NaCl substrate. Special techniques are described for stripping and mounting of the self-supporting targets. Examples of the improvement in the results for self-supporting compared with carbon-backed targets are shown.

10267 **(BNL—35310) Design criteria and sensitivity calculations for multielemental trace analysis at the NSLS x-ray microprobe.** Gordon, B.M.; Jones, K.W. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 21p. (CONF-841117—31). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004055.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

Synchrotron radiation from the National Synchrotron Light Source (NSLS) will be used for x-ray fluorescence elemental analysis at a spatial resolution of several micrometers. The initial phase in the development of the microprobe beam line will consist of obtaining a 30-μm beam spot for application to scanning x-ray fluorescence analysis. The proposed beam line will have a multilayer monochromator and an ellipsoidal mirror to provide monochromatic x rays from 3 to 17 keV and 8:1 demagnification. Ray tracing was carried out to establish the flux of excitation photons at the target for different orientations of beam line components. These alternative layouts will be discussed in terms of optimizing experimental conditions and trace element sensitivities. Calculated sensitivities for thin biomedical and geological matrices will be presented. 16 references, 5 figures, 1 table.

10268 (BNL—51778, pp 331-336) **HE-jet system to study short-lived fission product nuclei at LAMPF.** Talbert, W.L. Jr.; Bunker, M.E.; Starner, J.W. (Los Alamos National Lab., NM). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Experiments have been performed at LAMPF which demonstrate the feasibility of utilizing a He-jet system to transport fission products to an on-line mass separator from a target chamber mounted in the 800-MeV, >600μA main proton beam. Activities of essentially all elements produced are transported with about 60% absolute efficiency, both for fission reactions and spallation reactions. Transport times are short enough to allow study of activities with half-lives as short as 300 ms. Technical features and scientific possibilities of the system are presented.

10269 **(CONF-8410202—1) Prospects for a deuterium internal target, tensor polarized by optical pumping: spin exchange.** Green, M.C. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004072.

From IUCF workshop on nuclear physics with stored cooled beams; Spencer, IN, USA (14 Oct 1984).

The prospects for a tensor polarized deuterium target (~ 10^{15} atoms/cm^2) appropriate for nuclear physics studies in medium and high energy particle storage rings are discussed. Using the technique of electron spin exchange with an optically pumped sodium (or potassium) vapor, we hope to polarize deuterium at a rate ~ 10^{17} atoms/sec. Predictions for the deuterium polarization for a particular target cell design will be presented leading to the identification of the required optical pumping power and cell wall depolarization probability to attain optimum performance. The technical obstacles to be surmounted in such a target design will also be discussed.

10270 **(INP—1168-PH) Some aspects of the applications of wire chambers in high energy physics experiments at large accelerators.** Turala, M. (Institute of Nuclear Physics, Krakow (Poland)). 1982. 107p. (In Polish). NTIS (US Sales Only), PC A06/MF A01. File Number DE84703426.

An application of proportional and drift chambers in four large spectrometers at the accelerators of IHEP Serpukhov and CERN Geneva is described. An operation of wire chambers at high intensities and high multiplicities of particles is discussed. The results of investigations of their efficiencies, spatial resolution (for one and two-dimensional readout) and long term stability are presented. Problems of preselection of a given class of events are discussed. The systems for preselection of defined multiplicities or a scattering angle of particles, in which proportional chambers have been used, are described and the results of their application in the real experiments are presented.

10271 (INS-NUMA—42, pp 110-116) **Power supplies of the synchrotrons for NUMATRON project.** Mutou, M. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1982. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780063. (CONF-8112108—Exc.).

From Workshop on accelerator in NUMATRON; Tanashi, Tokyo, Japan (8 Dec 1981).

Power supplies of the synchrotrons that are expected to be constructed in "NUMATRON" project were designed. The two synchrotrons, 1st-Synchrotron and 2nd-Synchrotron, have the magnetic rigidities of 117.94KG-m and 457.91KG-m, respectively, so that the maximun energies in 1st-Synchrotron are 400Mev/u for all kinds of ion, and the ones in 2nd-Synchrotron are 4.46Gev/u for uranium ions and 12.83Gev for protons. Each power supply for the synchrotrons consists of motor-generator set, thyristor equipments and DC filters. The peak power and the average power are 46.9MW and 1.7MW, respectively for 1st-Synchrotron, and 42.5MW and 4.0MW, respectively for 2nd-Synchrotron. The repetition rate is 1Hz. The stabilities of the excitation current and the tracking errors of both synchrotrons are +- 10^{-4} and +- 5 x 10^{-4}, respectively throughout the excitation pattern. In order to achieve these performances, the control system needs some computers. This report describes the constitution and the characteristics of the power supplies.

10272 (INS-NUMA—42, pp 134-138) **Future rings for a cyclotron.** Inoue, Makoto (Osaka Univ., Suita (Japan). Research Center for Nuclear Physics). Sep 1982. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780063. (CONF-8112108—Exc.).

From Workshop on accelerator in NUMATRON; Tanashi, Tokyo, Japan (8 Dec 1981).

Various booster/storage rings for a cyclotron in the future are considered: ia) 1 GeV-proton energy variable ring cyclotron, ib) super conducting ring cyclotron for K-meson factory, ii) cooling ring for precise experiments, iii) pulse stacking storage ring for TOF experiments: iv) phase expansion storage ring for neutron physics, and v) pulsed extraction from the cyclotron to connect with a synchrotron.

10273 (INS-NUMA—42, pp 139-144) **Conceptual design study of radiation shielding of NUMATRON.** Nakamura, Takashi (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1982. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780063. (CONF-8112108—Exc.).

From Workshop on accelerator in NUMATRON; Tanashi, Tokyo, Japan (8 Dec 1981).

This conceptual design study of radiation shielding of NUMATRON has been performed by dividing into the following three stages: (1) The total neutron yield was evaluated for various combinations of projectiles and targets to be used in the NUMATRON accelerator, and the projectile-target combination to produce maximum neutron yield was identified considering the accelerating energy and the beam intensity; (2) The thickness of accelerator shield wall was determined so that the dose rate on the outer shield surface becomes less than 0.68 mrem/h, based upon Moyer's model and O'Brien's model; and (3) The dose level at the site boundary was calculated by use of Thomas', Alsmiller's and Nakamura-Kosako's formulas, and the site area was determined to keep that dose level under 5 mrem/y.

10274 (INS-NUMA—42, pp 145-148) **Design study of the control system for the NUMATRON.** Watanabe, Shinichi (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1982. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780063. (CONF-8112108—Exc.).

From Workshop on accelerator in NUMATRON; Tanashi, Tokyo, Japan (8 Dec 1981).

10275 (INS-NUMA—42, pp 156-158) **Software of the network system. The condition of the simple software development.** Chiba, Kurazo (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1982. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780063. (CONF-8112108—Exc.).

From Workshop on accelerator in NUMATRON; Tanashi, Tokyo, Japan (8 Dec 1981).

10276 (LA—10138-MS) **Thirty-five years of drift-tube linac experience.** Knowles, H.B. (Los Alamos National Lab., NM (USA)). Oct 1984. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005235.

The history of the drift-tube linear accelerator (linac) for the first 35 years of its existence is briefly reviewed. Both US and foreign experience is included. Particular attention is given to technological improvements, operational reliability, capital investment, and number of personnel committed to drift-tube linac (DTL) development. Preliminary data indicate that second- and third-generation (post-1960) DTLs have, in the US alone, operated for a combined total period of more than 75 machine-years and that very high reliability (>90%) has been achieved. Existing US drift-tube linacs represent a capital investment of at least $250 million (1983). Additional statistical evidence, derived from the proceedings of the last 11 linear accelerator conferences, supports the view that the DTL has achieved a mature technological base. The report concludes with a discussion of important recent advances in technology and their applications to the fourth generation of DTLs, many of which are now becoming operational.

10277 (LA-UR—84-3627) **Fixed-target option for the SSC.** Colton, E. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 4p. (CONF-8406198—30). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003739.

From Design and utilization of the superconducting super collider summer study; Snowmass, CO, USA (23 Jun 1984).

Three questions addressed are: (1) is slow extraction technically and economically feasible at the SSC; (2) can gas jet targets be used parasitically to produce secondary beams; (3) how can parasitic test beams be obtained during collider operation. 15 references. (GHT)

10278 (TRI-PP—84-96) **Status and recent progress toward the extraction of H^- ions at TRIUMF.** Dutto, G.; Craddock, M.K.; Laxdal, R.; Mackenzie, G.H.; Richardson, J.R.; Zach, M. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility). Oct 1984. 10p. (CONF-8410203—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85900433.

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

This scenario summarizes briefly the status and plans at TRIUMF and explains why the extraction of a cw beam of H^- from the existing machine together with the creation of a stable bright high peak intensity beam inside the machine now receive high priority. All cyclotron improvements which can make these goals easier, like a third harmonic flat-topped rf waveform, stable rf voltage and magnet and bright H^- ion source conditions, are also being vigorously pursued. The concepts and the plans for the H^- extraction program, together with the state of some of the other efforts are described.

10279 (UTNL-R—0122, pp 61-69) **TOF experiments and plans at OKTAVIAN.** Takahashi, Akito (Osaka Univ., Suita (Japan). Faculty of Engineering). Feb 1982. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780068.

In Report of the Technical Research Committee in time of flight experiments, 1980 and 1981.

A high flux D-T neutron generator (OKTAVIAN) has been constructed at Osaka University. The pulsed neutron beam with the pulse width of about 2 ns can be obtained. The peak D current is about 10 mA. The TOF experiments are designed to measure the double differential neutron emission cross sections, to study on neutron transport, and to establish spectroscopic technique. The length of flight path is 8.5 m. The neutron detector is a NE-213 detector. The performance characteristics were studied. The angular distribution of generated neutrons, and angle dependence of neutron energy were measured. The energy dependence of the detection efficiency of the detector was also measured. A test experiment of DDX measurement was performed with carbon and aluminum scatterers. The results were compared with the calculation by the NITRAN code, using the END F/B-4 file. Neutron penetration spectra through planar samples (graphite, iron and lead) were observed. The results were also compared with the calculation by NITRAN.

10280 (UTNL-R—0122, pp 79-86) **TOF experiments by JAERI Linac.** Mizumoto, Motoharu (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1982. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780068.

In Report of the Technical Research Committee in time of flight experiments, 1980 and 1981.

The TOF experiments performed at the JAERI-LINAC facility are described. The TOF system was equipped to the 120 MeV linear accelerator (LINAC) of Japan Atomic Energy Research Institute (JAERI). Five flight paths are provided. The length of the flight paths is in the range between 18.5 m and 190 m. Neutrons are produced through the Ta(γ, Xn) reaction. The detector is shielded from gamma flash by a lead ring. The neutron spectra from the target are measured by a Li-6 glass scintillator and a B-10 NaI detector. The spectra in MeV region are measured by a NE-213 detector. The neutron transmission through a Rb-87 sample was measured to obtain the total cross section in the keV region. The obtained spectrum was analyzed by the Breit-Wigner formula. The measurement of U-238, Br-79 and Br-81 was also performed. The scattering cross sections were measured by a combination detector of Li-6 and Li-7 scintillators. The neutron capture and scattering cross sections of W with various thickness were observed. The capture cross sections were obtained by observing the prompt gamma-ray. A large liquid scintillator was used for the detection of gamma-ray. The capture cross sections of Sm-149 and Ag-109 in the keV region were also observed.

10281 (UTNL-R—0122, pp 9-18) **Present status of the linac TOF experiments at Hokkaido University.** Akimoto, Tadashi (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering). Feb 1982. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780068.

In Report of the Technical Research Committee in time of flight experiments, 1980 and 1981.

The neutron spectrum measurement by TOF was designed. In this report, the experimental set-up and preliminary experiments are described. At first, the steady spectra in an assembly was analyzed by the SN method. The time-dependent spectra were also analyzed by the SN method. The target for neutron production was made of tungsten, and set in a spherical graphite assembly. There are an electron beam hole and a re-entrant hole in the graphite assembly. Collimators were set in the flight path, and Cd plates were set to remove thermal neutrons. The detectors were a Li-6 glass scintillator for keV neutrons and a NE-213 scintillator for MeV neutrons. The accuracy of measurement was estimated for energy and neutron intensity. The overall accuracy of 5 percent can be attained. The efficiency calibration of a fast neutron detector was made by using a Cf-252 source. The counting loss in the time-to-pulse-height converter (TPHC) was corrected.

10282 (UTNL-R—0122, pp 103-107) **Measurement of characteristics of a neutron target.** Sukegawa, Toshio; Yanagi, Shuji; Wakabayashi, Hiroaki (Tokyo Univ., Tokai, Ibaraki (Japan). Nuclear Engineering Research Lab.). Feb 1982. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780068.

In Report of the Technical Research Committee in time of flight experiments, 1980 and 1981.

The characteristics of a neutron target equipped to the electron linear accelerator (LINAC) at the University of Tokyo was measured. The target consists of tantalum target and a graphite block which removes excess electrons passing through the Ta

target. The generated neutron dose was measured in a lead intermediate neutron column. The temperature and the strain of the tantalum target and the graphite block were measured by thermocouples and strain-gauges. The temperature of cooling water was also measured by a thermo-couple. The measurement in case of the assumed emergency (loss of coolant) was performed by stopping the coolant flow. The spatial distribution of absorbed dose and the temperature at the time of operation were measured. The temperature rise of the graphite block at 100 pps of the electron pulse repetition rate was less than 10 degree C. The temperature rise of the Ta target was in a linear relation with the repetition rate of pulses. The generated strain at the repetition rate of 50 pps was in good agreement with the calculation. The strain at the repetition of 200 pps was calculated. The rate of temperature rise was estimated from the results of the loss of coolant experiment and the temperature measurement after the stop of electron beam. The rate was 12.1 degree C per sec on the back of the Ta target, 3 degree C in cooling water and 1.3 degree C on the graphite surface. The maximum temperature rise at the maximum operation power was estimated.

4304 Storage Rings

REFER ALSO TO CITATION(S) 43040010272

10283 **(CERN—84-02) Radiation problems in the design of the large electron-positron collider (LEP).** Fasso, A.; Goebel, K.; Hoefert, M.; Rau, G.; Schoenbacher, H.; Stevenson, G.R.; Sullivan, A.H.; Swanson, W.P.; Tuyn, J.W.N. (European Organization for Nuclear Research, Geneva (Switzerland)). 5 Mar 1984. 98p. NTIS (US Sales Only), PC A05/MF A01. File Number DE84703427.

This is a comprehensive review of the radiation problems taken into account in the design studies for the Large Electron-Positron collider (LEP) now under construction at CERN. It provides estimates and calculations of the magnitude of the most important hazards, including those from non-ionizing radiations and magnetic fields as well as from ionizing radiation, and describes the measures to be taken in the design, construction, and operation to limit them. Damage to components is considered as well as the risk to people. More general explanations are given of the physical processes and technical parameters that influence the production and effects of radiation, and a comprehensive bibliography provides access to the basic theories and other discussions of the subject. The report effectively summarizes the findings of the Working Group on LEP radiation problems and parallels the results of analogous studies made for the previous large accelerator. The concluding chapters describe the LEP radiation protection system, which is foreseen to reduce doses far below the legal limits for all those working with the machine or living nearby, and summarize the environmental impact. Costs are also briefly considered.

10284 (INS-NUMA—42, pp 98-103) **Beam stacking experiments at TARN.** Katayama, T. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1982. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780063. (CONF-8112108—Exc.).

From Workshop on accelerator in NUMATRON; Tanashi, Tokyo, Japan (8 Dec 1981).

After the first success of beam injection in TARN, August of 1979, beam experiments have been performed in succession to show the overall stacking number of approximately 300 turns, 15 RF stackings and 20 multi-turns. These results are in the close agreements with the theoretical calculations and it is now believed that the stacking method used at TARN is quite useful for the accelerators of protons and heavy ions.

10285 (INS-NUMA—42, pp 159-161) **Control system of Tristan.** Kurokawa, Shin-ichi (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1982. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780063. (CONF-8112108—Exc.).

From Workshop on accelerator in NUMATRON; Tanashi, Tokyo, Japan (8 Dec 1981).

10286 **Application of the Green's function method to some nonlinear problems of an electron storage ring. Pt. 1. The Green's function for the Fokker-Planck equation.** Kheifets, S. (Stanford Linear Accelerator Center, CA). *Particle Accelerators;* **15**: No. 2, 67-82(Jul 1984). Contract AC03-76SF00515.

One of the most important characteristics of an electron storage ring is the size of the beam. However analytical calculations of beam size are beset with problems and the computational methods and programs which are used to overcome these are inadequate for all problems in which stochastic noise is an essential part. Two examples are, for an electron storage ring, beam-size evaluation including beam-beam interactions, and finding the beam size for a nonlinear machine. The method described should overcome some of the problems. It uses the Green's function method applied to the Fokker-Planck equation governing the distribution function in the phase space of particle motion. The new step is to consider the particle motion in two degrees of freedom rather than in one dimension. The technique is described fully and is then applied to a strong-focusing machine.

10287 **Application of the Green's function method to some nonlinear problems of an electron storage ring. Pt. 2. Checking the method by a quadrupole perturbation.** Kheifets, S. (Stanford Linear Accelerator Center, CA). *Particle Accelerators;* **15**: No. 2, 83-97(Jul 1984). Contract AC03-76SF00515.

The method is applied first to the case of a field-gradient (linear) perturbation. The effect of a global gradient error in a weak-focusing machine and the effect of a local gradient error in a strong-focusing machine are considered. The distribution function of a particle bunch for a perturbed lattice in these cases can be written explicitly. The expansion of this distribution function as a series of perturbation terms produces the first and the second-order corrections to the unperturbed function. From them the corresponding second moments are calculated. A similar expansion of the distribution function is found by the Green's function method described in Part I. The second moments are found independently with the help of this distribution function. The comparison of these two results is a way of checking the method and calculations. Two important points have arisen. The first is the rule of summation over subsequent kicks experienced by a particle going through a perturbation. The second is that it might be better to use for the unperturbed distribution function that obtained by including the linear part of the perturbing force into the machine lattice. The perturbation should then contain only the nonlinear part of the force.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 4401009883, 10281, 10511, 10528

10288 **(AD-A—144637/6) Study of total gamma spectra correlation for extending identification range over photopeak analysis. Master's thesis.** Dooley, A.W. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1984. 154p. (AFIT/GNE/PH—84M-2). NTIS, PC A08/MF A01.

This report shows that gamma spectra identification by total flux correlation can be used to extend identification range over photo peak methods. Identification was based on two decision rules both employing cross-correlation coefficients. The largest coefficient (first decision rule) matched the unknown spectra with the correct source thirty-seven out of thirty-eight trials. The proposed likelihood function (second decision rule) had a success rate of thirty-five out of thirty-eight trials. These results were based on spectra generated by the transport code, Morse.

10289 **(AEEW-R—1748) Photon and neutron calibration of thermoluminescent dosemeters for reactor measurements.** Knipe, A.D. (UKAEA Atomic Energy Establishment, Winfrith). Jan 1984. 13p. HMSO, London, price $4.00.

The absolute photon energy deposition calibration procedure and the fast neutron response of ^{7}LiF thermoluminescent dosemeters (TLD-700) have been studied experimentally. The results, and their application, are examined in the context of the mixed radiation environment of a zero power fast reactor.

10290 (ANL/PHY—84-2, pp 227-230) **Preparation of conductive polypropylene films for parallel plate avalanche counters.** Dmytrenko, P.; Gallant, J.L.; Horn, D.; Steer, M.G. (Chalk River Nuclear Laboratories, Ontario). 1983. NTIS, PC A12/MF A01. File Number DE84017599. (CONF-8309127—).

From International Nuclear Target Development Society workshop; Argonne, IL, USA (7 Sep 1983).

A technique is described for evaporating a conductive coating on stretched polypropylene films. These are used as electrodes in a parallel plate avalanche counters for heavy ions. The stretching technique is briefly described. Stretched polypropylene films also have applications as windows for high-vacuum isolation, soft x-ray proportional counters, gas absorption cells, and energy-loss nuclear detectors.

10291 (BNL—35487) **Thermoluminescence kinetics in materials exposed to the low doses applicable to dating and dosimetry.** Levy, P.W. (Brookhaven National Lab., Upton, NY (USA)). Nov 1984. Contract AC02-76CH00016. 27p. (CONF-8409192—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85004382.

From 4. international seminar on TL and ESR dating; Worms, F.R. Germany (1 Sep 1984).

Thermoluminescence (TL) kinetics have been investigated for low dose situations applicable to dating, dosimetry, and recent geological deposits. Studied were the general one-trap kinetic equation, which reduces to the well known 1st and 2nd order kinetic equations when various assumptions apply, and the interactive kinetic equations, which describes TL in materials exhibiting more than one glow peak. In materials with one glow peak area varies linearly with dose; however, peak height is not linear with dose unless the TL obeys 1st order kinetics at all doses. In materials with two or more glow peaks neither peak height nor peak area varies linearly with dose, except in special situations. In fact, many peak height vs dose curves will be supralinear with the initial low-slope region occurring at relatively low doses. These considerations indicate: (1) Dating and dosimetry technique based on assumed linear peak height vs dose curves will usually underestimate the accumulated dose. (2) Dating techniques can be improved and/or made more reliable by determining the TL kinetics of the glow peaks measured.

10292 (BNL—35492) **Calorimetry for the SSC.** Gordon, H.A.; Grannis, P.D. (Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA)). 1984. Contract AC02-76CH00016. 13p. (CONF-8406198—28). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004645.

From Design and utilization of the superconducting super collider summer study; Snowmass, CO, USA (23 Jun 1984).

The activities related to calorimetry at Snowmass took place in three main areas. These were: (1) The performance criteria for SSC calorimetry, including the requirements on hermeticity, shower containment, segmentation and time resolution. The use of calorimetric means of particle identification was studied. (2) The study of triggering methods using calorimeter energy, angle and timing information. (3) A review of a wide variety of calorimeter materials for absorber and sampling, as well as several means of obtaining the readout of the energy deposits. 48 references, 10 figures, 1 table.

10293 (BNL—35595) **X-ray position detection at 22 μm FWHM with a gas proportional chamber.** Smith, G.C.; Fischer, J.; Radeka, V. (Brookhaven National Lab., Upton, NY (USA)). Nov 1984. Contract AC02-76CH00016. 6p. (CONF-841007—37). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004701.

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

Measurements have been made of x-ray position resolution in proportional chambers using xenon/CO_2, argon/CO_2, and hydrocarbon gases. The use of several atmospheres of gas pressure to reduce photoelectron range, and a very low noise position readout, have made it possible to observe more clearly the behavior of position resolution with anode avalanche size. Resolution begins to degrade above a critical avalanche size, whose value varies inversely with gas pressure. For 5.4 keV and 8 keV x-rays in 5 atm. Xe/10% CO_2, a resolution of 22 μm FWHM is measured, provided the anode avalanche is not greater than $\sim 10^6$ electrons.

10294 (CONF-841005—3) **In-beam tests of an air-core superconducting-solenoid particle spectrometer.** Stern, R.; Recchetti, F.; Casey, T.; Janecke, J.; Lister, P.; Kovar, D.; Janssens, R.; Pardo, R.; Vineyard, M.; Kolata, J. (Michigan Univ., Ann Arbor (USA). Dept. of Physics; Argonne National Lab., IL (USA); Notre Dame Univ., IN (USA)). 1984. Contract W-31-109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004029.

From Instrumentation for heavy ion nuclear research conference; Oak Ridge, TN, USA (22 Oct 1984).

We have assembled and tested a moderately sized air-core superconducting solenoid spectrometer. The spectrometer solid angle is defined by one of five interchangeable apertures of various shapes and sizes and a small Faraday cup ($\Delta\theta = +\text{-}4^{\circ}$), located inside the scattering chamber, which can be removed to include smaller angles. Initial testing was done using an α source with a solid state detector at the focal point. In-beam tests were subsequently performed at the ANL superconducting linac. One set of tests consisted of a series of exposures of ca. 8x8 cm plastic track detectors (CRONAR) located at the focal plane and centered on the mechanical axis. Small-angle elastic scattering of ^{32}S+Au (E = 90 MeV) and ^{16}O+Au (E = 76 MeV) was imaged on the detectors with various fields and entrance apertures, to study focusing properties and aberrations. The track detectors were suitably etched and the track density digitized using a CCD camera. The actual focal point is displaced lightly (~ 1 cm) from the mechanical center, and there is an azimuthal dependence in the aberrations which is not completely understood. A more complete set of measurements was taken using an XY-ΔE-E-TOF detector. This detector consisted of two separate 1 cm-thick charge-division proportional counters with 20 μm quartz-carbon wires oriented along the X and Y axes. These were backed (in gas) by a 100 μm thick, 600 mm^2 silicon surface-barrier (SiSB) detector for E and TOF. The beam was tuned for a pulse width ≦ 250 psec with 20 nsec between pulses. A fast time pickoff on the SiSB detector yielded particle TOF with a resolution ~ 450 psec, which was limited by the SiSB detector size and quality. Thus this system can, in principle, provide complete particle identification with a mass resolution ~ 1/100.

10295 (CONF-8408132—2) **^{205}Tl experiment.** Henning, W.; Kutschera, W.; Ernst, H.; Korschinek, G.; Kubik, P.; Mayer, W.; Morinaga, H.; Nolte, E.; Ratzinger, U.; Mueller, M. (Argonne National Lab., IL (USA); Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik; Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). 1984. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004031.

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

^{205}Tl has been previously proposed as a geological detector for solar neutrinos, making use of the reaction ^{205}Tl(nu, e$^-$)^{205}Pb with a neutrino threshold of only ≃ 43 keV. We report on an experiment performed to study the feasibility of detecting radioactive ^{205}Pb nuclei (T/sub 1/2/ = 15 million years) at very low concentrations using the recently developed technique of accelerator mass spectrometry. Employing the high-energy ion beams of good quality from the UNILAC heavy-ion accelerator at the GSI Darmstadt, we are able to demonstrate a suppression of neighbouring isotopes to better than 1 in 10^{16} and of neighbouring elements to about 1 in 10^3. While these results are very encouraging, the minimum number of atoms detectable is still severely limited by the efficiency of producing multiply-charged ions from present ion sources. Future improvements in ion-source performance are briefly discussed.

10296 **(FNAL-TM—1209) Applications of Bonner sphere detectors in neutron field dosimetry.** Awschalom, M.; Sanna, R.S. (Fermi National Accelerator Lab., Batavia, IL (USA); USDOE Environmental Measurements Lab., New York). Sep 1983. Contract AC02-76CH03000. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004259.

The theory of neutron moderation and spectroscopy are briefly reviewed, and moderators that are useful for Bonner sphere spectrometers are discussed. The choice of the neutron detector for a Bonner sphere spectrometer is examined. Spectral deconvolution methods are briefly reviewed, including derivative, parametric, quadrature, and Monte Carlo methods. Calibration is then discussed. (LEW)

10297 (HMI-B—411, pp 78) **Inelastic scattering using spallation sources.** Price, D.L. 1984. Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). (CONF-840874—).

From Symposium on neutron scattering; Berlin, F.R. Germany (9 Aug 1984).

Published in summary form only.

10298 (HMI-B—411, pp 79) **Use of area detectors in single crystal studies on spallation sources.** Schultz, A.J.; Leung, P.C.W.; Williams, J.M.; Brenner, R.; Strauss, M.G. 1984. Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). (CONF-840874—).

From Symposium on neutron scattering; Berlin, F.R. Germany (9 Aug 1984).

Published in summary form only.

10299 **(INP—1169/PL) Radon concentration and exhalation measurements with semiconductor detector and electrostatic precipitator working in a closed circulation system.** Wojcik, M.; Morawska, L. (Institute of Nuclear Physics, Krakow (Poland)). 1982. 42p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703453.

An apparatus is described and a method presented for the determination of concentration of radon emanated from solid and liquid samples. In this method an object or a sample of air is closed in an hermetically sealed chamber. The air contaminated by radon and its daughters is circulated in a closed system a few times through an electrostatic precipitator mounted in one housing with a Li-drifted Si semiconductor detector. The concentration of radon is determined by the alpha activity measurement of its daughters. The sensitivity of the apparatus is very high. While calculating a radon concentration from an activity measurement of RaA (fast method), the sensitivity is about 0.07 pCi/l, and when measuring the activity of RaC' (slow method), it is 0.008 pCi/l. Due to the application of an electrostatic precipitator and a silicon detector, it is possible to perform alpha spectrometric measurements and thus separate activities of RaA, RaC', and ThC and to calculate ^{222}Rn or ^{220}Rn concentrations. The efficiency of RaA, RaB, RaC, ThB and ThC collection is constant, due to the method involving the circulation of the air through the electrostatic precipitator several times.

10300 (JINR-D—3,4-82-704, pp 59-65) **Neutron diffraction optics at pulse neutron sources.** Mikhalets, R. (Joint Inst. for Nuclear Research, Dubna (USSR)); Mikula, P. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1982. (In Russian). NTIS (US Sales Only), PC A23/MF A01. File Number DE84780542. (CONF-820658—).

From 4. international school on neutron physics; Dubna, USSR (8 Jun 1982).

Possibilities of investigations and usage of neutron-optical effects at high-flux pulse neutron sources are considered. Experimental possibilities of the time-of-flight method in comparison with the two-crystal spectrometer method are shown. Possibilities of using time-of-fli ht dynamic neutron diffraction method for study on effects of external variable fields on solids and for the neutron interferometry method are considered.

10301 (JINR-D—3,4-82-704, pp 514-529) **Neutron spin echo and high resolution inelastic spectroscopy.** Mezei, F. (Institut Max von Laue - Paul Langevin, 38 - Grenoble (France); Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). 1982. NTIS (US Sales Only), PC A23/MF A01. File Number DE84780542. (CONF-820658—).

From 4. international school on neutron physics; Dubna, USSR (8 Jun 1982).

The principles of neutrons spin echo (NSE) technique are considered. It is shown that the basis of NSE principle is a single step measurement of the change of the neutron velocity in the scattering process. The backscattering spectroscopy and the NSE techniques are compared. The NSF spectrometer is described. It is shown that 0.5 MeV energy resolution achieved in the NSE experiment is about 40 times superior to those achieved by the other techniques. The NSE technique has the unique feature that provides high resolution in neutron energy change independently of the monochromatization of the beam. The NSE instrument not only covers a wider dynamic range on a pulsed source that on a continuous one, but also collects data more efficiently.

10302 (KEK—82-1, pp 573-586) **Detectors for gamma-gamma interaction studies.** Zorn, G.T. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). May 1982. NTIS (US Sales Only), PC A16/MF A01. File Number DE85780079. (CONF-8111151—).

From 2. workshop on detectors for TRISTAN; Tsukuba, Japan (6 Nov 1981).

First, the PLUTO detector, which has recently been improved for the $\gamma\gamma$ detection, is presented. The central magnetic field is 16.5 kG, and the momentum is measured with sigma (p)/p = 8 % . p(GeV/c). The central detector region has a good shower counter coverage down to theta = 15 deg. Tracking and muon coverage are down to theta = about 30 deg. The forward spectrometer has the theta angle coverage of 4.9 - 14.9 deg, and it can analyze 40 -- 50 % of particles from $\gamma\gamma$ - multihadrons. It can also identify electrons, hadrons below 1 - 2 GeV/c and muons having momentum over about 1 GeV/c. The shower counter placed before the quadrupoles, which are at distance of 4.4 m form the interaction point, detects electrons with theta = 1.6 - 4.3 deg. This PLUTO detector will be further improved to complete its transformation into a modern state-of-the-art detector, and will be installed in PLUTO after the 1982 run in preparation for the next PETRA run. Second, a new $\gamma\gamma$ detector is proposed, based on the following criteria: good solid angle coverage, compactness and optimization for the detection of single photon annihilation events. The angular coverage of this detector is theta = 6 - 90 deg. A central detector of jet chamber type has a 15 kG magnetic field, and enables a momentum precision of sigma (p)/p = 3% . p(GeV/c) and a dE/dx precision of about 18 % (FWHM). This detector would carry out electron identification with a liquid argon counter and dE/dx measurement. The practicality of this new detector remains to be demonstrated.

10303 **(LA—10153-MS) Effects of focusing on HRS focal-plane polarimeter measurements.** Fergerson, R.W. (Los Alamos National Lab., NM (USA)). Sep 1984. Contract W-7405-ENG-36. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004627.

The focusing properties of the High Resolution Proton Spectrometer cause mixing inside the spectrometer among scattered-particle polarization components in all three directions. This implies the need for a correction to the relations between focal-plane polarizations and polarization-transfer (PT) observables. One method for dealing with this problem is developed herein. The correction to the PT observables for angular regions at the edge of the spectrometer can be as large as 0.1 at an incident proton energy of 800 MeV. For data that are summed to produce one data point per spectrometer setting, this correction tends to be insignificant. At angles larger than 5°, it is sufficient to deal with corrections resulting from scattering off the spectrometer central momentum ray in the vertical and horizontal directions sequentially. This approximation greatly simplifies the implementation of this correction.

10304 **(LA—10264-MS) CYLTRAN calculations of electron effects on XD detectors.** Mayer, S.; Berzins, G.J. (Los Alamos National Lab., NM (USA)). Oct 1984. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005192.

Coupled electron-photon Monte Carlo calculations have been performed with the CYLTRAN code on a typical channel in a detector that has been flown aboard several spacecraft. The response of this channel has been examined as a function of incident electron energy over a range representative of background electrons in orbit. The signal is shown to arise from three separate regions whose relative importance changes with electron energy. Approximations used to cast the real problem into a format compatible with CYLTRAN are described.

10305 **(LA-UR—84-3577) Los Alamos energetic particle sensor systems at geostationary orbit.** Baker, D.N.; Aiello, W.; Asbridge, J.R.; Belian, R.D.; Higbie, P.R.; Klebesadel, R.W.; Laros, J.G.; Tech, E.R. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 13p. (CONF-850136—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003733.

From 23. AIAA aerospace sciences meeting; Reno, NV, USA (14 Jan 1985).

The Los Alamos National Laboratory has provided energetic particle sensors for a variety of spacecraft at the geostationary orbit (36,000 km altitude). The sensor system called the Charged Particle Analyzer (CPA) consists of four separate subsystems. The LoE and HiE subsystems measure electrons in the energy ranges 30 to 300 keV and 200 to 2000 keV, respectively. The LoP and HiP subsystems measure ions in the ranges 100 to 600 keV and 0.40 to 150 MeV, respectively. A separate sensor system called the spectrometer for energetic electrons (SEE) measures very high-energy electrons (2 to 15 MeV) using advanced scintillator design. In this paper we describe the relationship of operational anomalies and spacecraft upsets to the directly measured energetic particle environments at 6.6 R/sub E/. We also compare and contrast the CPA and SEE instrument design characteristics with the next generation of Los Alamos instruments to be flown at geostationary altitudes.

10306 **(NIKHEF-H—84-1-SING-2) Vertical position determination in the SING LEAR experiment.** Inge, A. van. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Feb 1984. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703452.

In this essay two points are discussed: (1) how a cathode read-out multiwire proportional chamber for the vertical position measurement is designed and where it is placed in the set-up of the SING-LEAR experiment; and (2) how the resolution of the vertical position measurement is calculated for this chamber. Three different centroid finding methods are used to determine the vertical position from the irradiated charge distribution on the cathode strips. They are: (a) a centre of gravity method; (b) a method called the 'Delft-method'; (c) a method based on the use of a table. For all of these methods, the resolution of the vertical position measurement are determined.

10307 **(PNL-SA—12263) Second generation ultralow background germanium gamma-ray spectrometer using super clean materials and improved multilayered cosmic ray anticoincidence and passive shielding.** Reeves, J.H.; Hensley, W.K.; Brodzinski, R.L. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 7p. (CONF-841156—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004549.

From Nuclear science symposium; Orlando, FL, USA (1 Nov 1984).

Our current paper describes the development of a low cost shielding system using liquid scintillator for the cosmic ray detector-neutron moderator which accounts for a tenfold reduction in the cosmic continuum. Our primary objective was to develop a low cost anticoincidence shield for laboratory use which would substantially reduce the background from cosmic ray interactions. The minimum thickness of scintillator which would provide the necessary moderation of neutrons as well as furnish detectable quantities of light generated from cosmic ray interactions was determined experimentally. Tanks holding the liquid scintillator were constructed from stainless steel and were partitioned in such a manner that 10, 20, 30, or 40 cm thicknesses could be selected for background measurements. Lucite was used for construction of a tank which would allow the comparison of light output relative to stainless steel for a 10 cm thickness of liquid scintillator. Plastic scintillator was used for the bottom layer in all cases, however, liquid scintillator could be used with proper internal support. A 20 cm x 20 cm x 40 cm plastic scintillator was machined to completely surround the detector and fit inside 15 cm thick walls of lead which in turn, fit inside the stainless steel scintilllator tanks. Background measurements were taken with this inner scintillator both active and inactive. Measurements were also made using copper as well as iron as replacements for the inner scintillator.

10308 **(PNL-SA—12611) Problems with radiological surveillance instrumentation.** Swinth, K.L.; Tanner, J.E.; Fleming, D.M. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 19p. (CONF-840774—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003017.

From Workshop on radiation survey instruments and calibrations; Gaithersburg, MD, USA (10 Jul 1984).

Many radiological surveillance instruments are in use at DOE facilities throughout the country. These instruments are an essential part of all health physics programs, and poor instrument performance can increase program costs or compromise program effectiveness. Generic data from simple tests on newly purchased instruments shows that many instruments will not meet requirements due to manufacturing defects. In other cases, lack of consideration of instrument use has resulted in poor acceptance of instruments and poor reliability. The performance of instruments is highly variable for electronic and mechanical performance, radiation response, susceptibility to interferences and response to environmental factors. Poor instrument performance in these areas can lead to errors or poor accuracy in measurements.

10309 **(RFP—3723) Reflective perspectives.** Yoder, R.E. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1985]. Contract AC04-76DP03533. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005182.

There is a need to provide to the radiation industry quality, reliable radiation detecting instruments. There is a need to provide an overall assessment of instrument performance under standard conditions but one must not overlook the importance of a qualified health physicist to assure the proper instrument selection for a measurement and the correct interpretation of the readings or data accumulated. Innovation in problem areas must be fostered to achieve advances in dosimetry, radiation measurements, and radiation control.

10310 (UTNL-R—0122, pp 1-8) **Neutron spectrum measurement by TOF.** Aizawa, Otohiko (Musashi Inst. of Tech., Kawasaki, Kanagawa (Japan). Atomic Energy Research Lab.). Feb 1982. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780068.

In Report of the Technical Research Committee in time of flight experiments, 1980 and 1981.

The TOF experiments by using various facilities are described. The steady neutron spectra in light water which contains non-1/V absorbing materials were measured by the TOF method at a LINAC facility. The results were compared with the calculations based on the Koppel-Haywood model and two others. The leakage neutron spectra from a heavy-water assembly were measured and compared with model calculations. The time-dependent energy spectra in a small graphite assembly were measured. For this measurement, a chopper system was also used. The two-region calculation explains the spectrum just after the neutron burst. The time-dependent spectra in a small Be assembly and in an assembly of coolant-moderator containing hydrogen were also measured. The calculations based on various models are in progress. The TOF experiments at the reactor-chopper facility were carried out for measuring the total cross sections of crystalline moderators, the thermal neutron total cross section of high temperature beryllium, the thermal neutron total cross sections of granular lead and high tempera-

ture liquid lead, and the angle-dependent scattering spectra. A pseudo-chopper was designed and constructed. The spectra of the neutron field for medical use were measured by the chopper-TOF system. The thermal neutron total cross sections of Fe, Zr, Nb and Mg were measured, and the results were compared with the calculations by THRUSH and UNCLE-TOM codes. The random-trigger TOF experiments were made by using Cf-252.

10311 (UTNL-R—0122, pp 92-97) **Evaluation of response functions of a REM counter and neutron dosimeters with cylindrical moderators.** Nakazawa, Masaharu; Iguchi, Tetsuo; Kohashi, Shuichi (Tokyo Univ. (Japan). Faculty of Engineering). Feb 1982. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780068.

In Report of the Technical Research Committee in time of flight experiments, 1980 and 1981.

The response functions of a REM counter and a neutron dosimeter were measured in the epithermal and the intermediate velocity regions by using a LINAC-TOF system. The efficiency curves for two types of the neutron dosimeters with moderators were measured and analyzed. The dead time correction of the time analyzer and the correction of time resolution were made for the data. The adjoint calculation by the ANISN code was made. The experimental and the calculated results were mutually compared. The preliminary works on the angle dependence of the efficiency of the detectors are in progress. As the results of this study, it was found that a method to obtain the energy dependent efficiency curves has been established. The correction of time resolution is important. The upper limit of the range of application of correction for energy is about 1 keV.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 4402009935, 10304

10312 **(AD-A—144713/5) Energy deposition in microvolumes of silicon from high energy proton reactions.** Bradford, J.N. (Rome Air Development Center, Griffiss AFB, NY (USA)). Feb 1984. 26p. (RADC-TR—84-5). NTIS, PC A03/MF A01.

Energy deposition by reaction secondaries issuing from high energy proton-silicon nucleus reactions is calculated. The basis of the calculation formalism is geometrical probability and follows from a direct analogue in radiobiology. Chord length (Track Segment Length), differential, and integral energy deposition distribution functions are calculated along with the first two moments of the distributions. The results enable description of energy deposition in microvolumes of silicon, for example, micro-electronic memory cells.

10313 **Radiation effects in TaSi/sub x//polysilicon MOS gate structures.** Draper, B.L.; McKeon, D.C. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* 2: No. 4, 723-729(Oct 1984). Contract AC04-76DP00789.

Silicide deposition methods, contamination of underlying oxide layers, and the use of high temperatures to crystallize the films are discussed in relation to their effects on radiation hardness. Large dose enhancement effects for photon energies $<$ or $\approx$300 keV are predicted for MOS devices using TaSi/sub x//polysilicon gate electrodes. However, experiments at 15, 100, and 1000 keV show no large differences in threshold voltage shifts among MOS capacitors using Al/poly, TaSi/sub x//poly, and W/poly gates. Among devices using various gate materials, differences in the amount of interface state generation and hole trapping within the gate oxide after irradiation are attributed to differences in the amount of mechanical stress in the oxide layers.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 4403009476, 9530, 9544, 9639, 9862, 10046, 10210, 10379

10314 **(ANL/EES-TM—266) Proceedings of the geoscience instrumentation workshop.** Rote, D.M. (ed.). (Argonne National Lab., IL (USA)). Oct 1984. Contract W-31-109-ENG-38. 48p. (CONF-8404216—). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004359.

From Geoscience instrumentation workshop; Argonne, IL, USA (19 Apr 1984).

A workshop was held to explore the question as to how collaborations between various universities, national laboratories, and companies might help alleviate some of the problems facing the geoscience community by assessing the nature and extent of the so-called instrumentation crisis. Issues of general interest to the geoscience community, issues of special interest to the academic community, and issues of interest to the national laboratories were addressed. The discussions of the several issues are summarized, and recommendations are made concerning many if not all of the issues, particularly concerning field and laboratory instrumentation. Issues include funding, access to facilities, off-the-shelf technology, and lack of well-trained staff. (LEW)

10315 **(ANL/FE—84-12) Electromagnetic acoustic transducers (EMATs) for erosion monitoring.** Reimann, K.J. (Argonne National Lab., IL (USA)). May 1984. Contract W-31-109-ENG-38. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004834.

Early detection, measurement, and monitoring of erosive wear rates can alleviate problems of unpredictable shutdowns, costly downtimes, and improper process operation. The first generation of a nondestructive, noninvasive acoustic-based system was tested on pressure boundaries of fossil energy conversion plants, yielding the desired information. Multiple transducers and wave guides are needed for such a system in order to determine wear profiles in large components. The same information could, however, be obtained with a single, scanning electromagnetic transducer (EMAT). Advantages of such EMAT-based systems motivated this investigation in order to establish criteria and requirements needed for erosion monitoring at elevated (operating) temperatures. The effort concentrated on three areas: (a) development of EMAT design parameters, (b) material-EMAT interaction, and (c) signal processing. Prototype horizontal shearwave EMATs, based on design parameters selected from computer calculations of the static field, were evaluated, and their performance was compared to the performance of piezoelectric transducers. Input power requirements for a larger than 10-dB signal-to-noise (S/N) ratio were established for various structural and hardfacing materials. Effects of surface roughness and temperature were determined for different test conditions. The results indicate that accurate wall thickness measurement can be performed at elevated temperature on rough surfaces as encountered, for instance, in a cyclone. Modern data processing such as signal averaging on correlation improves the S/N ratio from 12 dB to 26 dB and enables wall thickness measurements with an accuracy of +-0.25% of total wall thickness. Additional efforts are needed to determine requirements of EMATs in scanning mode and pulsed static field operation.

10316 **(CERN—84-05) Drilling and boring of a tube in composite Kevlar-epoxy material.** Souverain, J. (European Organization for Nuclear Research, Geneva (Switzerland)). 30 Apr 1984. 9p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703454.

The search coils for the high-precision measurement of the magnetic field of the LEP magnets have to be carried on a support tube of high specific modulus, in order to maintain the accuracy required. An aromatic polyamide fibre (aramide), Kevlar 49, in an epoxy matrix was chosen as the most suitable material. However, the manufacture of the supports involves the drilling of holes with high precision, and initial trials in the ISR (LEP) workshop produced poor results. Special tools were then successfully designed and manufactured on the basis of an analysis of the difficulties en-

countered. This report presents the cutting principles adopted and demonstrates the results obtained in the final product.

10317 **(KAPL—4181) Continuous measurement of zircaloy corrosion in air with an ultrasonic corrosion monitor.** Grossman, R.J. (Knolls Atomic Power Lab., Schenectady, NY (USA)). Nov 1984. Contract AC12-76SN00052. 23p. (CONF-8411119—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003663.

From IEEE ultrasonics symposium; Dallas, TX, USA (14 Nov 1984).

The Ultrasonic Corrosion Monitor (UCM) produces a continuous, in-situ, real-time characterization of corrosion film formation. The monitor, which measures its own corrosion, has a film thickness measurement resolution of better than 0.1 μm (0.004 mil). The technique is particularly well suited to severe or inaccessible environments, such as those experienced by nuclear materials, where standard corrosion measurement techniques require costly and time-consuming shutdown/measurement/startup cycles of the test facility. This report describes the physical basis for the UCM and presents the results of a corrosion experiment with a zircaloy ultrasonic monitor, which was exposed to 680°F air for over 7200 h. Ultrasonic corrosion measurements are made by continuously measuring the time-of-flight of an extensional ultrasonic wave along the axis of a corroding waveguide, such as a thin wire. As the waveguide corrodes, the different ultrasonic transmission characteristics of the base metal and the continually growing corrosion film cause a continuous change in the effective time-of-flight, which can be analytically related to the corrosion film thickness. The results of the zircaloy corrosion experiment demonstrate that the corrosion film thickness determined by the ultrasonic monitor corresponds directly to that determined by standard weight gain measurements. However, a typical in-reactor corrosion test would have accumulated no more than five weight measurements during the exposure time of this experiment, whereas the UCM produces a continuous measurement and, therefore, promises a level of corrosion characterization that has heretofore been unavailable. The UCM is expected to aid considerably in understanding and characterizing zircaloy corrosion. More generally, the concept is applicable to a broad range of materials and environments.

10318 **(LA—9771-MS) High-resolution SIT TV tube for subnanosecond image shuttering.** Yates, G.J.; Vine, B.H.; Aeby, I.; Dunbar, D.L.; King, N.S.P.; Jaramillo, S.A.; Thayer, N.N.; Noel, B.W. (Los Alamos National Lab., NM (USA)). Sep 1984. Contract W-7405-ENG-36. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85005189.

A new ultrafast high-resolution image shutter tube with reasonable gain and shuttering efficiency has been designed and tested. The design uses a grid-gated silicon-intensified-target (SIT) image section and a high-speed focus projection and scan (FPS) vidicon read-out section in one envelope to eliminate resolution losses from external coupling. The design features low-gate-interface capacity, a high-conductivity shutter grid, and a segmented low-resistivity photocathode for optimum gating speed. Optical gate widths as short as 400 ps +- 100 ps for full shuttering of the 25-mm-diam input window with spatial resolution as high as 15 lp/mm have been measured. Some design criteria, most of the electrical and optical performance data for several variations in the basic design, and a comparison (of several key response functions) with similarly tested 18- and 25-mm-diam proximity-focused microchannel-plate (MCP) image intensifier tubes (MCPTs) are included.

10319 **(LA—10274-MS) Portable electrochemical cell interrogator.** Doss, J.D.; McCabe, C.W. (Los Alamos National Lab., NM (USA)). Nov 1984. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005186.

We have designed a portable electronic instrument for interrogating electrochemical cells. The instrument is powered by a 9-V battery and has an LCD digital readout. It can read out any instrument that has electrochemical cells that increase in impedance upon deplating.

10320 **(N—84-32168) Theoretical design and analysis of the layered synthetic microstructure optic for the dual path X-ray telescope. Final Report, 1 March-31 May 1984.** Shealy, D.L.; Chao, S. (Alabama Univ., Birmingham (USA)). Jun 1984. 49p. (NASA-CR—171133). NTIS, PC A03/MF A01.

A ray tracing analysis was performed for several configurations for the inner channel of the dual path X-ray telescope, which is proposed to use the second mirror of the Stanford/MSFC Wolter-Schwarzchild telescope and a normal incident layered synthetic microstructure (LSM) mirror to form a secondary image near the front of the telescope. The LSM mirror shapes considered were spherical, ellipsoid, hyperboloid, and constant optical path length (OPL) aspheric. Only the constant OPL case gave good axial resolution. All cases had poor off axis resolution as judged by the RMS blur circle radius.

10321 **(N—84-33343) Optics and quantum electronics.** Fonstad, C.G.; Haus, H.A.; Ippen, E.P.; Kawakami, S.; Yamamoto, Y.; Stram, H.; Wintner, E.; Dagli, N.; Fujimoto, J.; Gabriel, C. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1984. 10p. NTIS, PC A12/MF A01.

In RLE program report No. 126, 31-40, N—84-33336 22-90.

The development of prototype optical waveguide devices that operate at rates of many tens of Gigabertz is discussed. A 20 GHz Mach-Zehnder waveguide interferometric sampler was built and tested. Devices for high-rate optical communications, all optical logic gates, and the theory of the soliton laser are also discussed.

10322 (NIRS-M—38, pp 11-22) **Liquid scintillation measurement.** Kusama, Keiichi (Shizuoka Univ. (Japan). Faculty of Science). 1982. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780072. (CONF-8012126—).

From 12. NIRS seminar on progress of isotope tracer techniques in biology and basic medicine; Anagawa, Chiba, Japan (4 Dec 1980).

Recent problems and new information on liquid scintillation measurement are described. Since the used solvent from scintillators must be stored in the facility, the solvent with high flash point becomes commercially available. The counting efficiency of various solvents for H-3 was examined. The p-Xylene showed the most effective counting efficiency. Pseudocumene can be used because of high flash point. The two-phase conditions of emulsified scintillators with the Pseudocumene were studied. The counting efficiency of the emulsified scintillators for H-3 was also studied. The relative counting efficiency and the merit, which is a product of the relative counting efficiency and the content of diluted mouse urine, were investigated in relation to the content of the mouse urine labelled by H-3. The relations between the merit and the content for other solutions were also studied. The use of mini-vials is considered to minimize the amount of spent solvent. Various types of mini-vials are designed. For the determination of counting efficiency, a new method called H number method was developed. This method can be applied to a sample with small amount and with strong quenching.

10323 **(PNL-SA—11294) Laser excitation kinetic phosphorimetry for uranium analysis.** Bushaw, B.A. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1983. Contract AC06-76RL01830. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005529.

Laser induced phosphorescence with time resolved photon counting detection has been used to measure uranium, as uranyl phosphate, in aqueous solution at room temperature. Demonstrated detection limits are below 10 parts per trillion. Multichannel scaler (MCS) photon counting is used for the rejection of laser and raman scattering, discrimination against prompt fluorescing species such as organics, and to provide a simultaneous determination of the uranyl emission lifetime. The lifetime is then used as a direct (photophysically correct) instrumental correction for matrix quenching and temperature effects. The MCS counting mode also allows rapid measurements (a few seconds at the ppb level, 5 minutes for pptr). Sample volumes of 2 to 3 ml have been used although 1/2 ml would be sufficient. The method has been used for: (1) evaluating

uranium contamination in ultrapure solvents and trace analytical procedures, in the low part per trillion range, (2) directly measuring (without chemical pretreatment or separation) urine samples at the 10 ppb level, (3) direct measurements on drinking and ground waters at the sub ppb level, and (4) using oxidative digestion as the only preparation, both urine and brine waters have been measured at the sub ppb level. For the brine water analysis the determined value (0.36 ppb) agreed within 10% of the number determined by U-233 tracer - iron hydroxide coprecipitation - filament source mass spectrometric analysis.

10324 **(SAND—80-2050) Technical manual: description and operation Slaved Tracking System.** Bauhs, K.C. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004807.

This manual contains physical and functional descriptions, operating procedures, and safety precautions for the Slaved Tracking System (STS). The STS is a mobile unit designed to provide close-up, high-quality motion pictures and video tapes of laydown bombs and rockets during the final phase of their trajectory to impact point. Radiometer devices mounted with the optics can also be used to track rocket exhaust emissions. The STS receives binary range and encoder information from Sandia's Laser Tracker System (LTS) to provide the STS with steering signals to track vehicle. These signals are transmitted by microwave or hard-wire communications lines. The communications link is shown in Figure 1-1. The STS yields optimum photographic coverage with a field-of-view of +-5 ft on targets traveling up to 2000 f/s at a cross range of 1500 ft. The boresight of the fixed optics points directly at a 12-in. gimballed tracking mirror that provides satisfactory photographic lighting under most conditions. A 75-mm-square flat-plate beamsplitter is used on the optical table to divide the gimbal mirror view between a 500-frame-per-second (FPS) motion picture camera and a shuttered, color, 60-field-per-second (fps) television camera. A video cassette recorder provides for immediate posttest analysis. The gimbal mirror and optical table are mounted on a steel pedestal weighing ~ 2 tons for maximum stability. The pedestal is leveled with three motor-driven screw jacks with lifting speed resolution of 0.002 to 0.05 in.-per-second.

10325 **Gauging film thickness: A comparison of an x-ray diffraction technique with Rutherford backscattering spectrometry.** Coulman, B.; Chen, H.; Rehn, L.E. (Department of Metallurgy and Mining Engineering and the Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Journal of Applied Physics;* **57**: No. 2, 643-645(15 Jan 1985).

An x-ray diffraction technique for determining thin-film thickness is presented which should prove to be a valuable alternative to the array of spectroscopies (Rutherford backscattering spectrometry, Auger electron spectroscopy, etc.) currently favored for these measurements. Some of the virtues of this x-ray diffraction approach are its nondestructive nature, fast data acquisition rate (enabling in situ observations), thickness resolution better than 5 nm, and conventional equipment requirements. Results are shown for Pd_3Si thin films grown during isothermal annealing of Pd coatings (100 nm) on Si at 200 °C for various amounts of time. A comparison of these x-ray measurements with Rutherford backscattering spectrometry data taken from the same specimens is used to demonstrate the validity of the x-ray technique.

10326 **Evaluation of Hamamatsu R1635 photomultiplier.** Lo, C.C.; Leskovar, B. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* **55**: No. 7, 1100-1103(Jul 1984). Contract AC03-76SF00098.

Characteristics of the Hamamatsu R1635 10-mm-diam photomultiplier have been measured. Some typical photomultiplier characteristics: such as gain, dark current, transit, and rise times: are compared with data provided by the manufacturer. Photomultiplier characteristics, generally not available from the manufacturer, such as the single photoelectron time spread and pulse response for full photocathode illumination were measured and are discussed.

10327 **High-performance coaxial EPR cavity for investigations at elevated temperatures and pressures.** Goldberg, I.B.; McKinney, T.M. (Rockwell International Science Center, Thousand Oaks, California 91360). *Review of Scientific Instruments;* **55**: No. 7, 1104-1110(Jul 1984). Contract AC22-80PC30072.

A microwave cavity suitable for heating a sample to temperatures above 800 °C within 15 s at gas pressures above 17.5 MPa is reported. The cavity is coaxial and operates in the TE_{011} mode at frequencies between 9 and 10 GHz. The heating element is constructed of nickel—chromium (i.e., Chromel) wire. It consists of two concentric helices wound in opposite senses (directions) and connected in series so as to minimize the magnetic field generated by the heater current. The heater is potted in magnesium oxide—phosphate ceramic and placed inside of a cylinder made from 50-μm copper foil which provides uniform temperature distribution and shields the heater from the microwave field. This assembly then serves as the heating element and the coaxial conductor of the cavity. The diameter of the coaxial heater assembly is approximately 7 mm. The sample is confined by a cylindrical quartz cuvette which surrounds the coaxial conductor. Sample thicknesses of 0.2 to 1.0 mm can be used. Heating from room temperature to 800 °C requires between 15 and 20 s. Operating pressures up to 17 MPa have been used, although the structural design limit of the brass or beryllium copper walls is greater than 22 MPa. Modulation coils are placed in recessed areas of the cavity walls and covered with a thin layer of copper. Cooling water flows through channels cut into the walls to maintain constant microwave parameters. Q factors of 8000 —12 000 can be obtained depending on the sample.

10328 **Densimetry in compressed fluids by combining hydrostatic weighing and magnetic levitation.** Masui, R.; Haynes, W.M.; Chang, R.F.; Davis, H.A.; Sengers, J.M.H.L. (Thermophysics Division, National Bureau of Standards, Washington, DC 20234). *Review of Scientific Instruments;* **55**: No. 7, 1132-1142(Jul 1984). Contract AI01-76PR06010.

A magnetic suspension densimeter is described that has been built for measuring the density of compressed liquids at pressures up to 15 MPa in the temperature range 20°—200°C with an uncertainty of 0.1%. The densimeter combines the principle of magnetic levitation of a buoy with that of liquid density determination by hydrostatic weighing. To accomplish this, the support coil is suspended from an electronic balance, and the balance readings are recorded (1) with the buoy at rest, and (2) with the buoy in magnetic suspension. Details are given of the construction of the cell, coil, buoy, and thermostat. The procedure is described by which cell and buoy are aligned so that the suspended buoy does not touch the cell wall. Test data on the densities of seven different liquids were obtained at room temperature. They agree with reliable literature values to within 0.1%. In a separate experiment, the bulk thermal expansion coefficient of the buoy material was determined. This experiment and its results are also given here.

10329 **High-temperature specimen holder for use with the PHI model 2100 specimen introduction/reaction chamber.** White, C.L.; Dimas, R.; Losch, W. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Review of Scientific Instruments;* **55**: No. 7, 1171-1172(Jul 1984). Contract W-7405-ENG-26.

A high-temperature specimen holder for use with a commercially available rapid specimen introduction device on an Auger electron spectroscopy system is described. Necessary (nondestructive) modifications to the specimen carousel are also included. Use of the specimen holder allows rapid transfer of specimens for in situ heating to approximately 1000° C during Auger analysis, while retaining conventional capabilities of the commercial system for ambient temperature analysis.

10330 **High resolution ultrasonic densitometer.** Dress, W.B. (Oak Ridge National Lab., TN). *Ultrasonics Symposium Proceedings;* 287-290(1983). Contract W-7405-ENG-26.

The velocity of torsional stress pulses in an ultrasonic waveguide of non-circular cross section is affected by the temperature and density of the surrounding medium. Measurement of the transit

times of acoustic echoes from the ends of a sensor section are interpreted as level, density, and temperature of the fluid environment surrounding that section. Methods of making these measurements to obtain high resolution, temperature-corrected absolute and relative density and level determinations of the fluid are examined. Possible applications include on-line process monitoring, a hand-held density probe for battery charge state indication, and precise inventory control for such diverse fluids as uranium salt solutions in accountability storage and gasoline in service station storage tanks.

10331 **Traveling wave ultrasonic transducer.** Baer, R.L.; Kino, G.S. (Stanford Univ., CA). *Ultrasonics Symposium Proceedings;* 498-501(1982). Contract AT03-81ER10865.

A new type of coupled-mode bulk acoustic wave transducer is described. Distributed, directional coupling is made possible by the use of an electrical delay line which slows the electrical signal into synchronism with the acoustic signal. Since the coupling is distributed, materials with low electromechanical coupling can be used to achieve highly efficient broadband transducers. Several configurations are described which use lumped element electrical delay lines and stacks of acoustic resonators. A theory, and experimental results, are presented.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 4501009518, 9524

10332 **(AD—801303/9) Scaled HE tests.** Doll, E.B.; Salmon, V. (Stanford Research Inst., Menlo Park, CA (USA)). Apr 1952. 116p. NTIS, PC A06/MF A01.

Report on Operation Jangle, Project 1(9)-1.

This series of four HE tests at the Nevada Test Site was conducted to provide information for scaled predictions for the shallow underground and surface nuclear tests. The results of the HE tests were quite satisfactory, and predictions were made only if justified by the demonstrated adherence to scaling laws within the HE test series. In addition, correlation with results from 1951 Dugway tests in dry clay was obtained. In general, the air blast scaled as predicted in both duration and amplitude. Acceleration scaling was good for the amplitude of the first smoothed pulse, but the durations did not scale. The sharp and highly damped oscillation acceleration due to air blast scaled as did air-blast pressure, but its period, as expected, increased less rapidly than the scale factor. Air-coupled phenomena were prominent due to the relatively shallow scaled charge depths, and appeared to predominate in earth accelerations at large distances. Analytical work on this topic should aid in explaining many of the effects observed. A comparison with Dugway results (for dry clay) from similar tests indicates that the earth-acceleration amplitudes and durations were approximately inverse to each other for the two soils.

10333 **(AD—801307/0) Some HE tests and observations on craters and base surges. Report for October-November 1951 .** Campbell, D.C. (Defense Atomic Support Agency, Washington, DC (USA)). 1 Nov 1951. 58p. NTIS, PC A04/MF A01.

Report on Operation Jangle, Project 1(9) - 3.

A series of HE Tests was planned at the Nevada Test Site preparatory to the nuclear explosions in Operation JANGLE. These HE shots were designed to obtain, under similar conditions, data to be used as a basis for making predictions concerning the phenomena to be studied during the nuclear explosions. The HE program, as originally conceived, was expanded to permit further study of the base surge and crater phenomena. Ten HE shots (a total of thirteen explosions) were conducted in the upper Yucca Flat and Frenchman Flat areas. Practically all of the instrumentation by the various participating agencies was done on the first series (HE-1 through HE-4). With a few minor exceptions, all instrumentation performed in a satisfactory manner. Shot HE-2 consisting of 40,000 pounds of TNT was fired with the c. g. 4.63 feet below the surface. There was a high order of detonation and the shot was completely successful.

10334 **(LA—10172-MS) High-temperature-stable detonators.** Dinegar, R.H. (Los Alamos National Lab., NM (USA)). Oct 1984. Contract W-7405-ENG-36. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005188.

Current experiments in the area of high-temperature-stable detonators involve using HMX, KP, HNS, and PYX explosives. The test devices employ both hot-wire flying-plate and slapper modes of operation. Hot-wire detonators using HMX as the donor explosive, with HMX, KP, and HNS as the intermediate acceptor material and HNS as the booster pellet, were successfully fired at temperatures as high as 225°C. Very limited success was achieved using PYX explosive in a few experiments. The program of investigation also calls for the development of a high-temperature-stable hot-wire device functioning in the DDT mode of operation. PYX explosive - a truly high-temperature-stable explosive - has been initiated to detonation by low-energy slapper foils.

10335 **(LA—10173-MS) Nonprimary-explosive, hot-wire detonator.** Dinegar, R.H. (Los Alamos National Lab., NM (USA)). Oct 1984. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005195.

A nonprimary-explosive, hot-wire detonator, employing the deflagration-to-detonation transition (DDT) process, has been developed. Pentaerythritol tetranitrate (PETN) is the explosive used. The assembly is nominally a 1-A/1-W/1-Ω system. The DDT process has been examined over a range of PETN specific surface values (3000 to 14,500 cm^2/g) and pressing densities (1.0 to 1.4 g/cm^3). The reaction is sensitive to the degree of subdivision and the compactness of the explosive in which the transition takes place. It apparently happens better with PETN of small specific surface loaded at low density. Consistent transitions from burning to detonation occur in PETN pressings 9 mm or more in length, with diameters of about 2 mm. Increasing the charge diameter by a factor of 2 appears to allow a shortening of the required charge length by several millimeters.

10336 **PHERMEX: pulsed high energy radiographic machine emitting x-rays.** Dick, R.D. (Los Alamos National Lab., NM). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* **312**: 246-256(1983).

The PHERMEX facility used to provide flash radiographs of explosives and explosive-driven metal systems is described. With this facility, precision radiographs of large objects containing materials with high atomic number and high density are attainable. PHERMEX encompass the high-current, three-cavity, 30-MeV linear electron accelerator; the 50-MHz radio-frequency power source to drive the cavities; timing, and signal detection system; and a data-acquisition system. Some unique features of PHERMEX are reliability; very intense sub-microsecond bremsstrahlung source rich in 4- to 8-MeV x rays; less than 1.0-mm-diam spot size; precision determination of edges, discontinuities, and areal-mass distribution; and flash radiographs of large explosive systems close to the x-ray target. Some aspects of the PHERMEX-upgrading program are discussed. The program will result in (1) an increased electron-beam energy to about 50 MeV, (2) the use of an electron-gun pulser that is capable of producing three-time-adjustable pulses for obtaining three radiographic pictures of a single explosive event, (3) an increased electron injection energy of 1.25 MeV, (4) the capability for recording high-speed signals, and (5) the use of computers to assist the monitoring and control of the data-acquisition system and the PHERMEX accelerator.

4502 Nuclear

REFER ALSO TO CITATION(S) 45020010445

10337 **(AD—363617/2) Shock winds, after-winds, and changes in air temperature resulting from large atomic bursts near the earth's surface.** Cowan, M. Jr. (Sandia Corp., Albuquerque, NM (USA)). May 1953. 60p. NTIS, PC A04/MF A01.

Report on Operation Ivy - Project 6.3 (U).

Project 6.3 of Operation Ivy was designed to obtain experimental measurements of some of the characteristic parameters (dy-

namic pressure, temperature, velocity of sound) of blast waves from nuclear explosions to the complete histories of such blast waves. Measured peak dynamic pressures (q), temperatures, and sonic velocities are compared with those predicted from the Rankine-Hugoniot relations on the basis of measured overpressures and ambient conditions. Within the range of experimental error there is reasonable agreement between these measured peak changes in dynamic pressure (peak particle or wind velocity and density) and temperature across the shock front and those calculated. Measurements of dynamic pressure and total head throughout the positive and negative phases were quite successful except at overpressure levels greater than 20 psi. Durations of positive and negative phase winds are found to be in agreement with the durations of the corresponding overpressures.

10338 **(AD—367502/2) Operation Crossroads. Tests Able and Baker. Bureau of aeronautics group final report.** (Joint Task Force One, Washington, DC (USA)). 18 Oct 1946. 277p. (XRD—157). NTIS, PC A13/MF A01.

Test data are summarized on airburst (Test Able) and underwater (Test Baker) nuclear explosion tests of naval aircraft. The Bureau of Aeronautics target aircraft exposure plans for Test ABLE had as their objective the determination of the effects of the atomic bomb upon aircraft as a function of distance from the center of the burst. Of the 73 aircraft originally provided for the air burst forty remained usable for the underwater bomb test. These forty aircraft comprised nineteen undamaged, ten lightly damaged and eleven moderately to heavily damaged aircraft which were considered, however, to be satisfactory test items.

10339 **(AD—367503/0) Operation Crossroads. Atomic Bomb Tests. Volume 7, Appendix X. Final report of Army ground group.** Frederick, J.D. (Joint Task Force One, Washington, DC (USA)). 27 Aug 1946. 260p. (XRD—156). NTIS, PC A12/MF A01.

See also Volume 6, Part 2, Appendix 9, AD-367 504.

Blast was the most destructive force acting against equipment exposed. The heat wave was of such short duration or low temperature that little damage occurred to Army Air Forces test items. Dispersion is an effective passive defense against atomic bomb attack. All aircraft instruments were unharmed by radioactivity. Methyl Bromide will retain radioactivity to a dangerous degree for an extended period. High pressure steel flasks, such as carbon dioxide bottles, will withstand extreme exposure to atomic detonation. No Army Air Forces exposed items were materially injured by radioactivity.

10340 **(AD—367504/8) Operation Crossroads. Atomic Bomb Tests. Volume 6, Part 2, Appendix IX. Final report of Army ground group.** Frederick, J.B. (Joint Task Force One, Washington, DC (USA)). 30 Sep 1946. 250p. (XRD—155). NTIS, PC A11/MF A01.

See also Volume 6, Part 1, Appendix 9, AD-367 505.

Potential fires within approximately 800 yards of the detonation center were extinguished by the closely following air blast, (except where high porosity of certain material enabled the heat radiation to penetrate) where as many distant fires would have been extinguished had the air blast been greater. Inflammability of fiber materials was greatly increased by presence of surface fuzz and high porosity. Objects having a cylindrical surface enabled the blast radiation to be directly normal to a portion of the surface and thus, if porous, penetrate deeper than would have otherwise been the case. The velocity of the air blast, and therefore its fire extinguishing power was greatly reduced by deck houses and other obstructions. Close packaging increased the fire hazard by forming crevasses where heat radiation could penetrate. Underground metal objects of a high surface/mass ratio that were directly exposed to the blast were the recipients of energy that manifested itself in the form of heat.

10341 **(AD—367505/5) Operation Crossroads. Atomic Bomb Tests. Volume 6, Part 1, Appendix IX. Final report of Army ground group.** Jordan, L.P. (Joint Task Force One, Washington, DC (USA)). 30 Sep 1946. 213p. (XRD—154). NTIS, PC A10/MF A01.

See also Volume 5, Appendix 8, AD-367 506.

Most of the damage caused by an atomic bomb burst in air is due to its heat wave and concussion effects, although within a few hundred yards some radioactivity, usually soon dissipated, is acquired by various types of material. When the burst takes place beneath the surface of the water, damage due to concussion and wave effects is limited to installations within close range, and a major consideration is the wide dispersal of persistent radioactivity.

10342 **(AD—367506/3) Operation Crossroads. Atomic Bomb Tests. Volume 5, Appendix VIII. Final report of Army ground group.** Frederick, J.D. (Joint Task Force One, Washington, DC (USA)). 27 Aug 1946. 213p. (XRD—153). NTIS, PC A10/MF A01.

See also Volume 4, Appendix 7, AD-367 507.

Chemical Warfare test items displayed in normal weather packaging and boxing withstood the effects of the atomic bomb. Dark colored containers were susceptible to the intense heat. Light colored containers, excepting rough wood surfaces, in the same area suffered no damage. Thin pliofilms could not withstand the heat at distances of 2300 yards or less from the blast. Plastics, as used in the containers of CWS Medical Kits, were susceptible to blistering and charring at distances of 1500 yards from the blast. One layer of flashproof cloth did not provide protection from the flash heat. Double and triple layers gave protection as close as 1000 yards.

10343 **(AD—367508/9) Operation Crossroads. Atomic Bomb Tests. Volume III. Final report of Army ground group.** Frederick, J.D. (Joint Task Force One, Washington, DC (USA)). 27 Aug 1946. 342p. (XRD—151). NTIS, PC A15/MF A01.

See also Volume 2, AD-367 508L.

From detonation of this bomb at the particular height used, it can be concluded that minimum horizontal range at which small, rugged, well built equipments with little shielding will remain operable is between 500 and 800 yards. Large sets of the SCR-3999, SCR-584 class remain operative, especially with minor shielding, at 1200 to 1500 yards. Precision radar at this distance will need mechanical reorientation before accurate fire-control can be resumed. Medium size equipment will be little affected at ranges intermediate between those stated above. Major damage at the Able Test was blast inflicted with the heat flash producing less serious effects.

10344 **(AD—367509/7) Operation Crossroads. Atomic Bomb Tests. Volume 2, Appendix V. Final report of Army ground group.** Smith, S.B. (Joint Task Force One, Washington, DC (USA)). 27 Sep 1946. 139p. (XRD—150). NTIS, PC A07/MF A01.

See also Volume 3 Appendix 6, AD-367 508.

With the exception of Searchlights and far Infrared devices (Penrod), Corps of Engineers Equipment will probably withstand the effect of an air burst of an atomic bomb of present design at a distance of 1000 yards. Improved resistance to blast can be provided by shock-mounting, shielding, and strengthening more fragile parts of equipment. Similarly, resistance to radiant heat can be provided by covering shielding, or by substitution of more heat-resistant materials. Lateral protection by employment of natural terrain or construction of revetments will reduce the radius of damage materially. The destruction of Corps of Engineers Equipment by use of an atomic bomb does not appear to be a profitable use of the bomb.

10345 **(AD—367510/5) Atomic Bomb Tests. Volume 1. Final report 27 January-27 September 1946.** Frederick, J.D. (Joint Task Force One, Washington, DC (USA)). 27 Sep 1946. 150p. (XRD—149). NTIS, PC A07/MF A01.

The atomic bomb used in this test is not an effective air burst weapon against field armies. Any commander who makes an intelligent use of terrain and cover, natural or artificial, and practices dispersion of personnel, equipment, ammunition and supplies in accordance with sound military doctrine can so minimize the effects of the bomb as to render its use by an enemy unprofitable. The atomic bomb should therefore be viewed as a strategic rather than a tactical weapon. Its greatest value will be found in use against concentrated targets where both its psychological and its material effects can be enormous. Its potential as a demoralizing

agent employed to destroy both the will and the power of a people to resist, by the shattering and leveling of their cities, is immeasurable. The fact that it can also be employed to cut off the source of supplies to field armies through methodical bombing of arsenals, manufacturing plants, storage areas, and transportation centers, concentrated as they now are in great cities, cannot be overlooked or minimized, for this is a more effective way of putting an army out of action than bombing the army itself. Obviously the bomb might also be used with telling effect against concentrated forward supply bases.

10346 **(AD—411296/7) Operation Sun Beam Shot Small Boy. Proj. officers report - project 1.7.** Pieper, F.A.; Barton, M.V.; Sauer, R.W. (TRW Space Technology Labs., Redondo Beach, CA (USA)). 3 Jul 1963. 39p. NTIS, PC A03/MF A01.

A total of 16 reed gages of a design which had previously been used in Operations Plumbob, Hardtack, Hardtack II, and Nougat were installed in the Small Boy Event. These gages recorded horizontal and vertical displacement shock spectra at four stations between 185 feet and 290 feet of ground zero. Some gages were placed at the surface and others at 10-foot depth. All gages yielded readable records and data is presented in both tabulated and chart form. The gages 10 feet below the surface showed a marked attenuation at high frequencies but very little attenuation of horizontal shock at frequencies below 50 cps and of vertical shock at frequencies below 25 cps. A peak was noted in horizontal acceleration be tween 90 and 150 cps at the surface and between 50 and 90 cycles at 10-foot depth. No similar peaks were noted in the vertical acceleration. Examination of the data presented indicated that no simple scaling was possible for the ground shock which occurred. This data will have to be studied with other shock spectra data so that it may be properly weighed, and quantitative scaling rules derived.

10347 **(AD—459098/0) Air shock pressures as affected by hills and dales. Summary report, March-June 1953.** Merritt, M.L. (Sandia Corp., Albuquerque, NM (USA)). Sep 1954. 36p. NTIS, PC A03/MF A01.

Report on Operation Upshot-Knothole, Proj. 1 1c2.

Measurements on Operation UPSHOT-KNOTHOLE Shot 7 consisted of ground-level pressures on a ridge to the west of the shot point, the same ridge that was instrumented on Shot 5 of TUMBLER-SNAPPER. Special attention was paid to measuring pressures farther fore and aft of the ridge than before and increasing the number of gages near the crest. Previous observations were confirmed in that pressures on the foreslope were higher (spiked waveforms) and those on the back slope lower (rounded waveforms) than would have been predicted at the same distance over flat terrain. Enough detail was obtained to show that these effects were caused by a compression wave from the initial upslope of the ridge and a rarefaction wave from the downslope at the crest of the ridge.

10348 **(AD—460273/6) Performance characteristics of clothing materials to thermal radiation.** Feldman, D.; Oesterling, J.F. (Army Natick Labs., MA (USA)). Jul 1955. 88p. NTIS, PC A05/MF A01.

Tests were conducted in which various fabric systems as used in U. S. Army clothing were exposed to the effects of atomic weapons. Samples were exposed to energies ranging from approximately 9 cal/sq cm to 75 cal/sq cm. Three of the fabric assemblies, each with and without a fire resistant treatment, corresponded to the same fabric systems on the animals used in Project 8.5. Fire resistant treatment did not enhance the resistance of the fabric to thermal transfer when the assemblies were in contact with the backing but was definitely superior to the untreated assembly when the combination was spaced away from the backing. In addition, other clothing fabrics, assemblies, and parameters were studied. The cold-dry and cold-wet assemblies offered the best protection against thermal transfer of any combination tested. In a comparative test of three underwear fabrics, the 50 per cent wool/50 per cent cotton was much better than an all cotton fabric of approximately the same weight. Both were very superior to the lightweight cotton underwear fabric. The wool/synthetic blended fabrics showed that for 15 per cent synthetic fiber there was very little or no difference from the all wool fabric regardless of the synthetic. With higher percentage blends the differentiation became greater. The higher the per cent of synthetic the poorer the resistance to thermal damage and heat transfer.

10349 **(AD—479249/5) Effects of thermal radiation on materials.** Monahan, T.I.; Derksen, W.L. (Naval Applied Science Lab., Brooklyn, NY (USA)). May 1954. 56p. NTIS, PC A04/MF A01.

Report on Operation UPSHOT-KNOTHOLE, Project 8.9.

The purpose of this project was to evaluate a physical skin simulant for determining the burn severity behind irradiated cloth barriers. The skin simulant consists of a polyethylene plastic, in the surface of which a thermocouple is imbedded to measure the associated temperature rise. The purpose of the project was to correlate exposures to the nuclear detonation with the corresponding exposures to laboratory sources of thermal radiation. Supporting measurements were made, including the spectral distribution of and the equivalent black-body temperature of the radiation incident at the several stations, employing passive-receiver calorimeters; evaluation of temperature-sensitive indicators for use with the physical skin simulant; the effect of duration of exposure on the extent of thermal damage; and the contribution of a material's absorptance and other material parameters to the total thermal damage to cloths.

10350 **(AD—482991/7) Field fortifications.** Fowler, A.R.; Muller, D.R. (Army Engineer Research and Development Labs., Fort Belvoir, VA (USA)). Dec 1954. 262p. NTIS, PC A12/MF A01.

Report on Operation Upshot-Knothole, Project 3.9.

Project 3.9 had four objectives, each directed toward filling a particular gap in the knowledge of atomic effects on and in field fortifications. Because each objective necessitated an independent experimental set-up and essentially constituted a test within itself, the report is presented in four parts: (1) General Effects on Field Fortifications; (2) Pressure Measurements in Field Fortifications; (3) Reflected Thermal Radiation in Foxholes; (4) Gamma Radiation in Foxholes.

10351 **(AD-A—144598/0) Investigation into the quasi-static phase of the surface burst source region emp (electromagnetic pulse). Master's thesis.** Hodgdon, K.M. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1984. 108p. NTIS, PC A06/MF A01.

A numerical solution was developed to find the above-ground late-time magnetic fields resulting from a surface nuclear burst. The time derivative in Maxwell's magnetic curl equation was ignored and the result was expressed in integral form using Stokes' law. This expression is expanded in spherical coordinates, the radical Compton current and the radical conduction current source terms were calculated, using the time-independent code, and the polar integrals were calculated. Magnetic field values were calculated and compared with analytic expression. For $r < 2$ Km, the results differed by less than 2.7. However, for $r > 2$ Km, the numerical values were an order of magnitude larger. The electric and magnetic field calculations were then used to test the spatial and temporal regions of validity of the simplified boundary condition and the quasi-static approximations. The assumption that the ground conductivity greatly exceeds the air conductivity leads to a simplified boundary condition at the earth's surface (E sub r = 0), and, in turn, to an inner radial limit to the validity of the results. The quasi-static approximation that the electric fields be derivable from a scalar potential determines the time regime over which the results are valid. The computer program included in this report is useful for late-time EMP calculations because of the short execution time and its wide range of applicability.

10352 **(AD-A—144797/8) Parametric study of high altitude nuclear EMP fields. Master's thesis.** Lavigne, R.J. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1984. 142p. (AFIT/GNE/PH—84M-10). NTIS, PC A07/MF A01.

A program is developed to model the electromagnetic pulse from a high altitude nuclear detonation. A Runge-Kutta numerical technique is used to solve for the electric fields. A continuous Fou-

rier Transform of the EMP is used to determine the frequency profile of the EMP. Parametric studies are performed to determine cause and effect relationships between burst parameters and the EMP frequency profile from 100 KHz to 100 MHz. Burst parameters studied are: gamma pulse time history, gamma ray energies from 1 MeV to 10 MeV, gamma ray yield, height of burst from 75 Km to 200 Km and intersection angle of the slant range with the geomagnetic field from 90 degrees to 30 degrees.

10353 **(AD-A—144978/4) Defense of Europe: a European perception. Student essay.** Van Der Vlis, A.K. (Army War Coll., Carlisle Barracks, PA (USA)). Apr 1984. 50p. NTIS, PC A03/MF A01.

Since its foundation in 1949 NATO has achieved remarkable success: the prevention of war with the Warsaw Pact. However, the continuation of relative peace in Europe is not assured. One of the present, disturbing developments is the decline of the cohesiveness of the Alliance. Different perspectives on the defense of Europe in the United States in the European countries are the main cause for this decline and are not well understood. This essay describes the European perception of NATO as a whole and the European perspectives on the nuclear and conventional aspects of the defense of Europe. The distinction between nuclear and conventional defense demonstrates the European perspective. Important aspects of the role of Europe in NATO in relation to the position and interests of the United States are discussed. Misunderstandings exist in this relationship on both sides of the Atlantic Ocean, which in turn render limitations upon Europe in its efforts to reinforce the European pillar of NATO. The essay concludes with a short and long term outlook on the future of NATO. Three subjects directly related to the future of the defense of Europe and of NATO are presented. These are: (1) Alternatives to the defense of Europe; (2) Implications of new technological developments; (3) Improvement of conventional capabilities.

10354 **(AD-A—145170/7) Ballistic missile defense, ICBM modernization, and small strategic attacks: out of the frying pan.** Lewis, K.N. (RAND Corp., Washington, DC (USA)). Mar 1983. 41p. NTIS, PC A03/MF A01.

The current Western strategy of Flexible Response represents a delicate balancing of the various interests and concerns held by the Allies on both sides of the Atlantic. The West's ability to launch small nuclear attacks--including attacks by U.S. central strategic systems--against a full range of militarily relevant targets currently is a keystone of the Flexible Response concept. To erode that strategy by undermining even in part our limited strategic attack capability could lead to a number of potentially severe political and military problems. For this reason, great caution is warranted as we consider certain strategic policy issues, most notably, whether to include active defense as a component of some follow-on U.S. ICBM system configuration. The author concludes that, as we make critical strategic choices over the next few months and years, it is vital to recall that U.S. and Soviet strategic aims and contexts are by no means symmetric ones. Certain key asymmetries--relating to the conventional theater balance, our need to achieve a political consensus for important weapons and strategy choices, and the like-should inform our ICBM modernization decisions in the near-term. Based on the discussion presented in this report it would seem that the net effect of such considerations would be to support every effort possible to devise an MX basing concept that does not rely on active defense.

10355 **(AD-A—145245/7) French nuclear forces.** Hyland, J.J. III. (Naval War Coll., Newport, RI (USA)). 5 May 1984. 42p. NTIS, PC A03/MF A01.

This paper briefly reviews French declaratory strategy, explores France's current and projected force structure, develops a first order approximation of her nuclear capabilities, and draws some implications from France's strategic modernization program. The analysis suggests that a middle-sized power can maintain an independent deterrent, although it imposes costs in conventional capacity and results in heavy dependence on its SLBM leg. Also, France's expanded strategic forces are generating renewed pressure for a reevaluation of her relationship with West Germany, the Atlantic Alliance, and NATO.

10356 **(CONF-8411122—1) Shadow of ground zero.** Haaland, C.M. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003505.

From American Civil Defense Association annual meeting; Daytona Beach, FL, USA (15 Nov 1984).

The history of the development of nuclear weapons starting with the detonation of the A-bombs on Japan is reviewed. An overview of nuclear weapon effects is presented. The effects of electromagnetic pulse (EMP), initial nuclear radiation, thermal radiation and blast are discussed with reference to how people outside can survive when ground zero is only a few miles away. 8 references. (ACR)

10357 **(LALP—84-47) Typical Los Alamos National Laboratory underground nuclear test.** Wolff, W.P. (Los Alamos National Lab., NM (USA)). Sep 1984. Contract W-7405-ENG-36. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004596.

Los Alamos MINI-Review.

In support of US nuclear weapon needs, LANL is engaged in the design, development, and testing of nuclear explosives. Since 1963, nearly all US nuclear tests have been conducted deep underground at the Nevada Test Site. This review describes a typical sequence of events for the weapon test of a device in a vertical drilled hole at NTS: preparations, safety precautions, device emplacement, and detonation. (DLC)

10358 **(SAND—84-1346) Sandia Technology, Vol. 8, No. 2.** (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85005197.

The following six papers are included: (1) technology for verifying nuclear arms control treaties, (2) satellite instruments for monitoring the Limited Test Ban Treaty, (3) buoys for collecting radioactive fallout, (4) instruments for verifying International Safeguards Agreements, (5) instruments for monitoring peaceful nuclear explosions, and (6) national seismic stations. (MOW)

4503 Explosion Detection

10359 **(AD—374651/8) Seismic measurements.** Crocker, J.A.; Harris, R.A. (Air Force Technical Applications Center, Patrick AFB, FL (USA)). May 1955. 87p. NTIS, PC A05/MF A01.

Report on Operation Upshot-Knothole, Project 7.4.

The objective of this project was to obtain seismic data out to 35 degrees geocentric angle, and to utilize these data in the establishment of criteria peculiar to the nature and propagation of seismic energy derived from nuclear blasts. New instrumentation and techniques were tested. Instruments were set up at appropriate locations to supplement those already in existence in the Atomic Energy Detection System net. Tests were conducted at the 5000 ft depth in a mine, and the ZIPAGRAM was tested. It was found that the capability of the Atomic Energy Detection System net has been greatly extended by recent improvements, and that the seismic energy received from a given shot at any given location varies with the geology at the station, the coupling factor at ground zero, and the altitude of the shot. It is recommended that temporary stations be established in the distance range of from 20 to 40 degrees from the Nevada Proving Ground. Data obtained in this distance range are needed tocalibrate the Atomic Energy Detection System stations similarly located with respect to foreign test sites. For this purpose, blasts of various energies and heights, occurring over differing geological conditions are desired.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

10360 (LALP—84-51) Tracking Antarctic winds. Mroz, E.J. (Los Alamos National Lab., NM (USA)). Oct 1984. Contract W-7405-ENG-36. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004597.

Los Alamos MINI-Review.

This Mini-Review summarizes ongoing research on Antarctic winds. The circumpolar and Katabatic flows are discussed. In addition the use of tracers in flowing wind flow is addressed.

10361 (N—84-30435) Global biogeochemistry: an overview. Moore, B. III. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1984. 3p. NTIS, PC A04/MF A01.

In earth observing system, Volume 1, Part 2: science and mission requirements, A5-A7 p, N—84-30433 20-42.

The dynamic biogeochemical equilibria among the major pools of carbon, nitrogen, sulfur, and phosphorus represented by terrestrial biomass, the world's oceans, and the troposphere are disturbed. Since even the most rapid processes of adjustments among the reservoirs take decades, new equilibria are far from established. These human-induced perturbations and the system's subsequent responses constitute an on-going biogeochemical experiment at the global level. Current and new information must be combined in a way that allows testing of various hypotheses about the workings of global biogeochemical systems. This enables assessment of current knowledge and evaluation of the gaps.

10362 (UCRL—91451) Oceanic role in terrestrial climate. Ellsaesser, H.W. (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 22p. (CONF-8409184—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004422.

From 13. international conference on the Unity of the Sciences; Washington, DC, USA (2 Sep 1984).

A review is given of the role of the oceans in terrestrial climatogenesis. The review leads to development of a criterion for recognizing areas of potential climatogenesis through atmosphere-oceanic interaction and to speculations as to the causes of the El Nino-Southern Oscillation events, the Medieval Little Optimum, Little Ice Age and 20th Century Arctic Warming of the North Atlantic and the glacial-interglacial cycles. 29 references, 6 figures.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 5002009430, 9488, 9496, 9497, 9503, 9504, 9510, 9958, 9973, 10043, 10428

10363 (ASCOT—84-7) Report on the ASCOT data analysis workshop. Nappo, C.J.; Barr, S.; Clements, W.E.; Yamada, T.; Neff, W.; Porch, W. (National Oceanic and Atmospheric Administration, Oak Ridge, TN (USA). Atmospheric Turbulence and Diffusion Lab.; Los Alamos National Lab., NM (USA); National Oceanic and Atmospheric Administration, Boulder, CO (USA). Wave Propagation Lab.; Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 43p. (CONF-8311213—Summ.). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004407.

From ASCOT data analysis workshop; Livermore, CA, USA (7 Nov 1983).

This Atmospheric Studies in Complex Terrain (ASCOT) workshop was convened to identify and formulate critical questions and hypotheses concerning the physics and modeling of transport and diffusion in drainage flows, and to ascertain the degree to which existing data can provide insight into these questions and hypotheses. The intent was not to seek immediate solutions, but to discuss the problems, consider unanswered questions, and determine whether the existing data are sufficient to provide the answers. Specific areas considered were: evaluation of the spatial and temporal variability of drainage flow along slopes and within basins; evaluation of pooling region phenomena; evaluation of current theories of drainage flow on simple slopes; flow characteristics of Brush Creek, Colorado with application to future field experiments. 14 references, 4 figures, 1 table.

10364 (BNL—35624) Ground measurements of air chemistry during CAPTEX 83. Hayes, J.V.; Benkovitz, C.M. (Brookhaven National Lab., Upton, NY (USA)). Oct 1984. Contract AC02-76CH00016. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85005134.

The Cross-Appalachian Tracer Experiment (CAPTEX) conducted in September and October 1983 was primarily directed toward measurements of the emitted tracer gas but some participants also measured air quality. Ground level air quality measurements from state-operated monitoring sites were obtained to supplement the air quality measurements taken during the CAPTEX field program. These measurements are described and documented in this report. There are data from a total of 122 sites in six states. 3 references, 9 tables.

10365 (CONF-841237—1) Development of a monthly historical emissions inventory. Knudson, D. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004085.

From 1. annual acid deposition emissions inventory symposium; Raleigh, NC, USA (3 Dec 1984).

As atmospheric transport and deposition modeling capabilities increase and monitoring data are accumulated, it becomes desirable to also refine emissions inventories. One such refinement is the application of monthly fuel use and industrial production data to define the intra-annual variability of emissions. This is the general approach being taken to portion the 1980 NAPAP SO_2 emissions to monthly values. The data bases for disaggregating annual emissions are Energy Information Administration Form 759 (formerly Form 4) for electric utilities; the Quarterly Coal Report for coal use by industrial and commercial/institutional sources; Federal Reserve Board (FRB) monthly industrial production indices for industrial processes; industry-specific fuel use and FRB monthly production indices for oil and gas use by industrial boilers; and heating degree-day accumulation for space heating for all fuels. Monthly SO_2 inventories are being prepared for utility ad nonutility sectors for the period 1975 to 1983. This paper presents 1980 monthly SO_2 emissions for New York and West Virginia for the subject sectors. 5 references, 2 tables.

10366 (N—84-29366) Development of air sulfur concentration in Finland through the year 2000. Estlander, A. (Finnish Meteorological Inst., Helsinki). 1982. 85p. (In Finnish). NTIS, PC A05/MF A01.

The Finnish regional development of sulfur dioxide and sulfate concentrations was examined. International predictors concerning emissions development were used to evaluate regional development of emissions levels in Finland. Future concentrations were estimated with the use of linear connections between emissions and concentrations obtained with a trajectory model developed in long-range transport studies. The findings indicate that the Finnish regional sulfur dioxide levels will not increase appreciably by 1985, but that sulfate concentrations will rise significantly. By the years 1990 and 2000, sulfur dioxide levels will be twice as high as they are at present, and sulfate levels will increase by fifty percent. In the larger Finnish cities, long-term averages of local sulfur dioxide concentrations are affected by temperature and the degree of district heating. Local long-term concentrations are expected to decrease in Finnish cities by the end of the century, but this effect will be offset by regional increases. Development of short-term concentrations appears to be totally dependent on local circumstances.

10367 **(ORNL—6064) User's manual for UTM-TOX, the unified transport model.** Patterson, M.R.; Sworski, T.J.; Sjoreen, A.L.; Browman, M.G.; Coutant, C.C.; Hetrick, D.M.; Murphy, B.D.; Raridon, R.J. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 433p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE85004954.

The multimedia model UTM-TOX has been developed for the US Environmental Protection Agency at the Oak Ridge National Laboratory. This model combines hydrologic, atmospheric, and sediment transport in one computer code. The information for the use of UTM-TOX in application to environmental transport problems is presented. The modular coupling established among the submodels is described, the structures of the model and each submodel are presented, subroutine descriptions are given for each subprogram, and sample input and output are given as guides to the user. The range of the atmospheric transport submodel, 50 km, is compatible with the maximum area for which the hydrologic model has been applied, approximately 1000 square kilometers. The sediment transport model has been designed to match the scale of the hydrologic model. The chemical processes considered in the model have been upgraded to include those necessary for the organics. The model calculates rates of flux of the chemical from release to the atmosphere, through deposition on a watershed, infiltration, and runoff from the soil to flow in the stream channel and the associated sediment transport. From these values, mass balances can be established, budgets for the chemical can be made, and concentrations in many environmental compartments can be estimated. Since the coupling is established among the three major submodels, they can share data; for example, the precipitation data is used both by the hydrologic model for runoff calculations and by the atmospheric transport model for estimates of wetfall deposition. 94 references, 31 figures, 27 tables.

10368 **(ORNL/TM—9243) Removal of hydrofluoric acid from gas streams by solid sorbents.** Brown, C.H. Jr.; Fowler, V.L. (Oak Ridge National Lab., TN (USA)). Jan 1985. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004943.

Removal of hydrofluoric acid (HF) vapor from gas streams via reaction with solid sorbents was investigated. The gas stream studied consisted of HF, steam, and nitrogen. The sorption process was studied in a bench-scale system using a plug-flow packed-bed reactor and the necessary ancillary equipment to deliver gas to the reactor and analyze the off-gas. Limestone and marble were eliminated as potential sorbents due to excessive calcium fluoride dust formation. Pebble quicklime (calcium oxide) was tested and found to be a very efficient scavenger for HF under controlled conditions. By first slaking the quicklime in situ the calcium utilization efficiency was measured to be 90%. The HF removal efficiency was also found to be very high, particularly during the first portion of a test when the HF concentration in the effluent was below the detection limit of the analysis method.

10369 **(PB—84-232537) Evaluation of the pollution episodic model using the RAPS data. Final report October 1982-February 1984.** Pendergrass, W.R.; Rao, K.S. (National Oceanic and Atmospheric Administration, Oak Ridge, TN (USA). Atmospheric Turbulence and Diffusion Lab.). Aug 1984. 71p. NTIS, PC A04/MF A01.

This report describes an evaluation of the Pollution Episodic Model (PEM) using the St. Louis Regional Air Pollution Study (RAPS) data. This evaluation is designed to test the performance of the model by comparing its concentration estimates to the measured air quality data, using appropriate statistical measures. Twenty days, ten summer and ten winter, are selected from the RAPS data base for the PEM evaluation. The model's performance is judged by comparing the calculated 12-hour average concentrations with the corresponding observed values for five pollutant species, namely, SO2, fine and coarse sulfates, and fine and coarse total mass. A first-order chemical transformation of SO2 to fine sulfate is considered in the calculations in addition to the direct emission and dry deposition of all five pollutants. The model domain, covering 125 x 125 km with a 50 x 50 receptor grid, includes 286 point sources and 36 area sources in the greater St. Louis urban area. Hourly meteorological data and detailed emission inventories for the five pollutants are used as inputs to the model. For the twenty PEM evaluation days, PEM predicted average concentrations of SO2, and fine and coarse sulfates to within a factor of two. The model overpredicted the average concentrations of fine and coarse total mass by a factor of three to four over the evaluation period. This is attributed primarily to overestimation of emission rates and incorrect location of area sources, which dominate the fine and coarse total mass emissions.

10370 **(PB—84-236850) Review of the attributes and performance of six urban diffusion models. Final report October 1982-September 1983.** White, F.D. (American Meteorological Society, Boston, MA). Aug 1984. 105p. NTIS, PC A06/MF A01.

The American Meteorological Society conducted a scientific review of a set of six urban diffusion models. TRC Environmental Consultants, Inc. calculated and tabulated a uniform set of statistics for all the models. The report consists of a summary and copies of the three independent model reviews conducted to evaluate the models. General conclusions included: (1) all of the six models are very similar to each other and represent simple approximations of the urban diffusion situations in a given time period with no horizontal variability of the boundary layer structure or depth; (2) none of the models can be considered state-of-the-art since a great deal has been learned about the planetary boundary layer that could be incorporated into such models; (3) the models all use an all or nothing approach to plume penetration; either the plume penetrates the elevated inversion and is lost to the computation or it is completely trapped; and (4) the four annual models all produced good estimates of the observed concentrations, while, of the short-term models, TEM-8A seriously overpredicted at night and RAM seriously underpredicts during the day.

10371 **(PNL—5152-Pt.1) OSCAR experiment high-density network data report: Event 1 - April 8-9, 1981.** Dana, M.T.; Easter, R.C.; Thorp, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1984. Contract AC06-76RL01830. 209p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85005096.

The OSCAR (Oxidation and Scavenging Characteristics of April Rains) experiment, conducted during April 1981, was a cooperative field investigation of wet removal in cyclonic storm systems. The high-densiy component of OSCAR was located in northeast Indiana and included sequential precipitation chemistry measurements on a 100 by 100 km network, as well as airborne air chemistry and cloud chemistry measurements, surface air chemistry measurements, and supporting meteorological measurements. Four separate storm events were studied during the experiment. This report summarizes data taken by Pacific Northwest Laboratory (PNL) during the first storm event, April 8-9. The report contains the high-density network precipitation chemistry data, air chemistry data from the PNL aircraft, and meteorological data for the event, including standard National Weather Service products and radar data from the network. 4 references, 72 figures, 5 tables.

10372 **(PNL—5152-Pt.3) OSCAR experiment high-density network data report: Event 3 - April 16-17, 1981.** Dana, M.T.; Easter, R.C.; Thorp, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1984. Contract AC06-76RL01830. 192p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85004907.

The OSCAR (Oxidation and Scavenging Characteristics of April Rains) experiment, conducted during April 1981, was a cooperative field investigation of wet removal in cyclonic storm systems. The high-density component of OSCAR was located in northeast Indiana and included sequential precipitation chemistry measurements on a 100 by 100 km network, as well as airborne air chemistry and cloud chemistry measurements, surface air chemistry measurements, and supporting meteorological measurements. Four separate storm events were studied during the experiment. This report summarizes data taken by Pacific Northwest Laboratory (PNL) during the third storm event, April 16-17. The report contains the high-density network precipitation chemistry data, air chemistry and cloud chemistry data from the PNL aircraft, and meteorological data for the event, including standard National Weath-

er Service products and radar and rawindsonde data from the network. 4 references, 76 figures, 6 tables.

10373 **(SNV-PM—1636) Ecological effects of acid deposition. Report and background papers 1982. Expert meeting 1.** (Statens Naturvaardsverk, Stockholm (Sweden)). 1983. 320p. (CONF-8206268—Pt.1). NTIS (US Sales Only), PC A14/MF A01. File Number DE85750164.

From Stockholm conference on the acidification of the environment; Stockholm, Sweden (21 Jun 1982).

This volume contains the contribution by the keynote speakers, the background papers and the report from the Expert meeting 1. The meeting discussed the following topics: Atmospheric processes, deposition-soil-water interactions, forest changes and water acidification-effects and counter measures. The conclusions drawn by the Expert meeting 1 refer in general to effects of both dry and wet deposition, collectively known as acid deposition. Acidification is understood as loss of neutralizing capacity of soils and waters. The Expert Meeting examined effects in aquatic and terrestrial ecosystems, but did not treat in any detail effects of pollutants on corrosion and health.

10374 **(SNV-PM—1637) Strategies and methods to control emissions of sulphur and nitrogen oxides. Report and background papers. Expert meeting II.** (Statens Naturvaardsverk, Stockholm (Sweden)). 1983. 181p. (CONF-8206268—Pt.2). NTIS (US Sales Only), PC A09/MF A01. File Number DE85750163.

From Stockholm conference on the acidification of the environment; Stockholm, Sweden (21 Jun 1982).

This volume contains the background papers and the report from the Expert meeting II. The meeting discussed the following topics: Desulphurization technologies, energy conservation, sulphur emissions, control programmes. The emphasis of the discussion has been on the control of sulphur oxides emissions as they are the most important source of acidifying compunds. Some considerations was given the control technology for nitrogen oxides from stationary sources. One important source for nitrogen oxides emission, motorized vehicles, was not dealt with, as this was felt to be a subject of its own. A reduction of sulphur and other emissions can also be achieved through energy conservation. The potential of this approach was included in the considerations.

10375 **(SNV-PM—1742) Air pollution in urban areas.** Gustafsson, J.Aa. (ed.). (Statens Naturvaardsverk, Solna (Sweden)). Nov 1983. 118p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750169.

The report is discussing the level of knowledge concerning: sources of emission, estimation of exposure, sampling, chemical analysis, reactions in the atmosphere and health effects of air pollution in urban areas. Research results from the different groups involved in the project are presented, including sampling of recipient air and automobile exhausts, chemical analysis and fractionation (particle and gas phase), mutagenic effects in collected samples, estimation of genetic risks, genetic effects on human cells, effects on liver metabolism, uptake of an effects on lung tissue, and effects on lung cells and lung tissue.

10376 **(SNV-PM—1763) Dry Deposition of Sulphur and Nitrogen Compounds.** Grennfelt, P.; Fowler, D.; Granat, L.; Haellgren, J.E.; Persson, C.; Richter, A. (Statens Naturvaardsverk, Solna (Sweden)). Dec 1983. 100p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750170.

In this report, factors affecting the dry deposition of sulphur dioxide to forest, agricultural land and lakes as well as the dry deposition of nitrogen dioxide to forests are discussed. By analyzing how the different factors affect the deposition, various deposition situations are defined. For each situation the deposition velocity and frequency are estimated for each month. From these data, the deposition of sulphur dioxide to forest, agricultural land lakes together with the deposition of nitrogen dioxide to forests are estimated. The estimates made for a place in southern Sweden (Velen, situated between the lake Vaenern and the lake Vaettern) indicate that the deposition of sulphur dioxide and nitrogen dioxide to the different types of surface vary considerably during the year. This is true especially for the deposition to agricultural land where it can be about three times higher in the spring and early summer than in the late summer due to the differences in the deposition velocity as well as in the concentrations. Moreover, it is shown that in Velen the yearly dry deposition of SO^2 and NO^2 is only 10 to 30 percent of the corresponding wet deposition of sulphate and nitrate, respectively.

10377 **(UCRL—91856) Evaluation and sensitivity study of the MATHEW/ADPIC models using EPRI Plains Site data for a tall stack.** Peterson, K.R.; Lange, R. (Lawrence Livermore National Lab., CA (USA)). Dec 1984. Contract W-7405-ENG-48. 19p. (CONF-8410165—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004992.

From DOE model validation workshop; Charleston, SC, USA (23 Oct 1984).

We have selected 3 of the 13 EPRI Plains Site intensive measurement periods for study; the 3 data sets are representative of a morning transition, daytime and an evening transition. For each period, we: (1) used measured plume heights, when available; (2) screened all meteorological input, especially the upper air winds; (3) used measured σ/sub θ/ values from the 100 m meteorological tower with an extrapolated σ/sub θ/ at the top of the computational grid; (4) employed a better boundary condition on the surface concentrations; and (5) used the latest version of MATHEW/ADPIC. With these changes calculated maximum SF_6 concentrations, paired in time but not in space, show much better correspondence to measurements than the earlier SAI calculations. A similar comparison between measurements and calculations using Briggs' plume heights indicates that using Briggs' formulation gives results that are inferior to calculations using measured plume heights. However, comparison of our calculations (paired in space and time) using measured vs Briggs' plume heights, with no changes in other input values, show only minor differences. This may largely be due to the type of ratio analysis used which weighs all samplers equally, regardless of the concentration level. 10 references, 6 figures, 3 tables.

10378 **Increasing carbon dioxide concentrations and climate: the transient response.** Hoffert, M.I.; Michael, P.A. (New York Univ., New York City). pp 259-279 of Carbon dioxide: current views and developments in energy/climate research. Bach, W.; Crane, A.J.; Berger, A.L.; Longhetto, A. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1983). (CONF-820794—). Contract AC02-76CH00016;AC02-81EV10610.

From Conference on climate and energy: carbon dioxide; Erice, Italy (16 Jul 1982).

Models are presented for the response of the climate system to increasing CO_2 concentrations under the influence of time-dependent, or transient, climatic forcing. In particular, an examination is made of the role that the oceans are expected to play in delaying the attainment of a given level of warming in the atmosphere. 16 references, 5 figures, 2 tables.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 5003009504, 9626

10379 **(IS-T—1161) Trace detection in gases using photoacoustic spectroscopy and Fabry-Perot interferometry.** Yip, B.C.Y. (Ames Lab., IA (USA)). Dec 1984. Contract W-7405-ENG-82. 209p. NTIS, PC A10/MF A01; GPO Dep. File Number DE85004174.

Thesis.

Two thermooptic-based detection systems for gases were developed and studied for their performances in monitoring air pollutants. In the first system which is based on the photoacoustic effect, a continuous-wave carbon dioxide laser was adapted for operation in the infrared with its output wavelength modulated between two consecutive vibration-rotation lines. This was accomplished by applying a time-varying electric field to a commercial piezoelectric pusher attached to the grating mount of the laser. Operating under wavelength modulation, the primary limitation on detectability in photoacoustic measurements - window absorption - was removed

and the useful range for application was extended. This concept was illustrated by the determination of ppB levels of ethylene in nitrogen. In the second system, the feasibility of using Fabry-Perot interferometry for in situ trace detection of gases was studied. Two experiments were performed with a single frequency helium neon (HeNe) laser acting as a probe beam. The first one was based on a dual-beam arrangement, with direct measurement of the shift of interference fringe as a result of the change in refractive index caused by the absorption of excitation radiation by the species of interest. Because of certain instrumental limitations, the full potential of this scheme as a sensitive device for trace gas detection was never quite realized. The second Fabry-Perot interferometric experiment was based on a single-beam geometry using modulated excitation and coherent detection of the signal. A laboratory built position stabilization circuit was employed to maintain the interferometer at its optimum point of operation. By combining this with wavelength modulation, the projected detection limit of the resulting scheme for C_2H_4 in nitrogen was found to be 20 ppB (S/N = 3). 225 references, 42 figures, 7 tables.

10380 **(PNL—5345) Hanford Environmental Monitoring Program schedule for samples, analyses, and measurements for calendar year 1985.** Blumer, P.J.; Price, K.R.; Eddy, P.A.; Carlile, J.M.V. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1984. Contract AC06-76RL01830. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004102.

This report provides the CY 1985 schedule of data collection for the routine Hanford Surface Environmental Monitoring and Ground-Water Monitoring Programs at the Hanford Site. The purpose is to evaluate and report the levels of radioactive and nonradioactive pollutants in the Hanford environs, as required in DOE Order 5484.1. The routine sampling schedule provided herein does not include samples scheduled to be collected during FY 1985 in support of special studies, special contractor support programs, or for quality control purposes. In addition, the routine program outlined in this schedule is subject to modification during the year in response to changes in site operations, program requirements, or unusual sample results.

10381 **Characterising the source of radon indoors.** Nero, A.V.; Nazaroff, W.W. (Lawrence Berkeley Lab., CA (USA)). *Radiation Protection Dosimetry;* 7: No. 1-4, 23-39(1984). (CONF-831049—).

From International seminar on indoor exposure to natural radiation and related risk assessment; Capri, Italy (3 Oct 1983).

Average indoor radon concentrations range over more than two orders of magnitude, largely because of variability in the rate at which radon enters from building materials, soil and water supplies. Determining the indoor source magnitude requires knowledge of the generation of radon in source materials, its movement within materials by diffusion and convection, and the means of its entry into buildings. The state of understanding of indoor radon sources and transport is reviewed. The understanding of generation rates in and movement through building materials is relatively complete and indicates that, except for materials with unusually high radionuclide contents, these sources can account for observed indoor radon concentrations only at the low end of the range observed. The understanding of how radon enters buildings from surrounding soil is poorer; however, recent experimental and theoretical studies suggest that soil may be the predominant source in many cases where the indoor radon concentration is high.

10382 **Measurements of the deposition rates of radon daughters on indoor surfaces.** Toohey, R.E.; Essling, M.A.; Rundo, J. (Argonne National Lab., IL (USA)); Hengde, W. (North China Inst. of Radiation Protection, Taiyuan, Shanxi). *Radiation Protection Dosimetry;* 7: No. 1-4, 143-146(1984). (CONF-831049—).

From International seminar on indoor exposure to natural radiation and related risk assessment; Capri, Italy (3 Oct 1983).

The deposition rates of radon daughters on indoor surfaces have been measured by exposing the window of a proportional counter to the air of a house with high concentrations of radon and its daughters. Deposition velocities for unattached RaA and RaB of approximately 4 $mm.s^{-1}$ were obtained by dividing the deposition rates by the concentration of unattached daughters in the air. These results agree with those obtained by other workers but are dependent on the assumptions made about the fractions of the daughters which are attached to the atmospheric aerosol.

5006 Regulations

REFER ALSO TO CITATION(S) 50060010398

10383 **(ANL/EES-TM—264) Environmental protection appraisals: a suggested guide for US Department of Energy field organizations.** Barisas, S.; Polich, J.; Surles, T.; Habegger, L.; Anderson, D.; Opelka, J.; Frangos, T. (Argonne National Lab., IL (USA)). Aug 1984. Contract W-31-109-ENG-38. 102p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85004688.

This manual has been prepared to help DOE field organizations conduct environmental protection appraisals of DOE operating-level facilities. Its primary use will be by DOE operations offices in their appraisal of facilities operating under the authority of the Atomic Energy Act. However, the manual can also be used by other DOE field organizations. This manual was developed to facilitate the appraisal process by providing operations office staff with a choice of modules that can be used independently or as a unit. The manual gives guidelines for reviewing information submitted to the operations office before the site visit and for conducting an on-site operating-level appraisal.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 51010010361

10384 **(N—84-30440) Land biology.** Kanemasu, E.T. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1984. 3p. NTIS, PC A04/MF A01.

In earth observing system, Volume 1, Part 2: science and mission requirements, A21-A23, N—84-30433 20-42.

The advancing technology of our civilization on Earth affects our environment on a local, regional and global scale. Local effects can feed into larger scale effects because of positive feedbacks in our system. The ability to understand, quantify and predict the large scale and long-term effects of technology is truly mind boggling. The understanding of these effects, which is paramount to the quality of life on Earth, will depend upon the ability to interact with scientists from the biological, atmospheric, oceanographic and geological sciences and develop a common communication system and unified objectives.

10385 **(ORNL/TM—8864) Habitat availability and animal community characteristics.** Seagle, S.W.; Shugart, H.H.; West, D.C. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 94p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85004945.

The microhabitat utilization and niche characteristics of Peromyscus leucopus, Ochrotomys nuttalli, and Blarina brevicauda were examined within a pine plantation on the Oak Ridge National Environmental Research Park (NERP) in East Tennessee. Although general microhabitat utilization was the same, niche parameters (such as niche breadth) for each species varied between two study grids, apparently in response to differing understory density. Specialization is thus proposed to be a function of local microhabitat structure. Removal of the generalist species, P. leucopus, from one grid while maintaining the other as a control elicited a significant microhabitat shift and increase in niche breadth by O. nuttalli. B. brevicauda displayed a slight but nonsignificant microhabitat shift and increased niche breadth. These results are a counter example to the hypothesis that generalist species are poor competitors. Spatial microhabitat heterogeneity created by plant secondary succession and extrinsic disturbances such as tree blow-down is suggested to allow coexistence of these species by altering competitive

abilities or microhabitat selection at a small spatial scale. Since interspecific competition affects small mammal niche characteristics, two hypotheses to explain the relative abundances of coexisting animal species are examined. Analysis of the small mammal fauna of the Oak Ridge NERP indicates that habitat availability, not niche breadth, is a good predictor of abundance. This result is discussed in the context of habitat dynamics and the evolutionary history of the species. 103 references, 10 figures, 10 tables.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 5102009508, 9575, 10367, 10373, 10376

10386 **(FLPU—83-6) Study of long term (10^3-10^4y) elemental migration in saturated clays and sediments.** Mackenzie, A.B.; Scott, R.D.; McKinley, I.G.; West, J.M. (Institute of Geological Sciences, Harwell (UK). Fluid Processes Unit). Mar 1983. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703461.

A 5m sediment core from L. Lomond, in which a well defined band of marine sediment resulting from the Flandrian marine transgression is present, was extensively analysed by INAA, XRF and α-spectrometric techniques. Approximately 10^3 concentration data points for elements including Na, K, As, Br, I, La, Sm, Sc, Cr, Fe, Co, Rb, Sb, Cs, Ce, Eu, Tb, Lu, Hf, Ta, U, Th and Ra are presented. From this large data set, some generalisations on the geochemistry of particular groups of elements (on a periodic table classification) are obtained. In addition, sorption data for Cs, Sr, Ce, Co, I, Tc and Np onto bulk samples of lacustrine and marine sediment were measured and analysed in terms of the expected speciation of these elements under experimental conditions. Using simple models of element remobilisation by diffusive and advective processes it is shown that the elemental profiles observed in-situ are not readily explained by variations in measured sorption. Of particular relevance is the apparent resistance of high I and Br concentrations in the marine layer to post depositional remobilisation. Possible explanations for the discrepancies between calculated and observed profiles are discussed and detailed proposals are advanced for a more rigorous investigation of these sediments.

10387 **(IVL-B—731) Metal contents of the moss surrounding an acidified lake at Bohuslaen. A study of distribution patterns and the burden of heavy metals in the district of Gaardsjoe.** Skaerby, L.; Goeransson, A. (Swedish Water and Air Pollution Research Lab., Goeteborg). Sep 1983. 24p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750193.

50 samples of Pleurozium schreberi have been collected and analysed. The moss of mixed conifers showed higher metal contents than the moss from clearings. The latter had high contents of Mn. The deposition of Co into pine-forest was calculated to 0.18 g per ha and year. The amount of Cr and Cu were 2.3 and 7.3 g, respectively.

10388 **(KHM-TR—73) Investigation of aged fly ash depositions at Asnesvaerket.** Hjelmar, O. (Statens Vattenfallsverk, Vaellingby (Sweden). Projekt KOL-HAELSA-MILJOE). Mar 1983. 81p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750155.

The objectives of the present study have been to investigate the hydraulic, physical, and chemical properties of fly ash deposited at old ash ponds and to detect whether leachate from the fly ash has penetrated into the underlaying seabed. The study was carried out at Asnaesvaerket during 1982 and involved two former ash ponds which had been filled up with fly ash 18-23 years ago and 2-4 years ago, respectively. The hydraulic conductivity in the saturated zone within the fly ash at the oldest of the two disposal sites, ash pond A, was determined at 1.8 times 10^{-5} - 3.4 times $^{-5}$ m/s by test pumping. The corresponding hydraulic conductivity at the younger disposal site, ash pond B, was 3 times 10^{-5} - 6 times 10^{-6} m/s. The alkalinity of the deposited fly ash at both sites is still comparable to that of fresh fly ash. Also, pH of the pore water/leachate has remained high. The major elemental components of the deposited fly ash are Al, Si, Fe, Ca, and O. The general concentration levels of the trace elements As, Cd, Cr (VI), and Pb in pore water and leachate from the old ash ponds are considerably lower than those found in the transport water which is discharged from operating ash ponds.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 5103009622, 9623, 9624, 9625, 9626, 10380, 10381

10389 **(BNL—35669-R) Production of radioactivity in local soil at AGS fast neutrino beam.** Gollon, P.J.; Hauptmann, M.G.; McIntyre, K.; Miltenberger, R.; Naidu, J. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 15p. (CONF-841187—23). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005125.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

Brookhaven National Laboratory (BNL) has recently decided to construct a new neutrino production target station at the Alternating Gradient Synchrotron (AGS). To determine the environmental impact of this addition, a study is being conducted in the vicinity of the old target area to determine the radiological consequences of operating this experimental facility. Typical BNL soil samples were placed at two locations near an operating target: at right angles to the target and behind thick shielding close to the direction of the incident beam. These samples were used to determine radionuclide production and leaching information. A core was taken from beneath the concrete floor of the old target area and a monitoring well was installed down-gradient of the facility. Preliminary results from all areas of the study are presented along with estimates of the potential environmental impact of the old and new facilities. 9 figures.

10390 **(DP-MS—84-76) Environmental gamma dose measurements in cities and towns near the Savannah River Plant.** Padezanin, P.C.; Ross, D.I.; Wright, C.N. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1985. Contract AC09-76SR00001. 9p. (CONF-850106—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003445.

From 18. midyear topical symposium of the Health Physics Society; Colorado Springs, CO, USA (6 Jan 1985).

The Savannah River Plant has maintained thermoluminescent dosimeters both inside and outside of public buildings at 57 cities and towns within a 50-mile radius of the plant since 1980. The dosimeters, which are replaced and processed quarterly, have provided backgound gamma radiation levels at these locations. In the event of a nuclear incident, the dosimeters would be collected and processed to determine the integrated dose to individuals in these areas. The data show that dose rates inside buildings ranged from 51 to 212 mR/y, while those outside the buildings ranged from 55 to 146 mR/y. Measurements at individual locations have been consistent over this time period. Differences between inside and outside measuements are attributed primarily to radioactivity in construction materials with a possible contribution from the buildup of radon and thoron that occurs in well-insulated, airtight buildings. 3 references, 3 figures, 1 table.

10391 **(RHO-ST—46P) Field calibration of computer models for application to buried liquid discharges: a status report.** Sisson, J.B.; Lu, A.H. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Aug 1984. Contract AC06-77RL01030. 462p. NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE85004461.

A field experiment for calibrating computer models was conducted. Data from the experiment were compared directly to the output of a computer model. The model inputs were estimated from in situ information and computer forecasts of moisture movement were made. The forecasts were biased at some points in the system. The bias could be removed by using improved estimates of the parameters. The model correctly forecast that horizontal movement would dominate in situ wetting patterns. 18 references, 21 figures, 5 tables.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 51050010443

10392 (LA—8050-NERP-Vol.2) Status of the flora of the Los Alamos National Environmental Research Park: a historical perspective. Volume 2. Foxx, T.S.; Tierney, G.D. (Los Alamos National Lab., NM (USA)). Sep 1984. Contract W-7405-ENG-36. 61p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004609.

Studies of the flora of the Los Alamos National Environmental Research Park (LA/NERP) are continued in Water and Pajarito Canyons and their extensions to natural boundaries outside the LA/NERP. Six plant communities and sixteen plant habitats are described for the plant communities and sixteen plant habitats are described for the study area. The status of endangered, threatened, and rare plant species in the study area is reviewed, and land-use history of the Pajarito Plateau is related to the levels of apparent anthropogenic disturbance in the study areas' six plant communities. 66 references, 20 figures.

5106 Regulations

REFER ALSO TO CITATION(S) 51060010383

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 52010010361

10393 (N—84-30438) Inland aquatic resources and biogeochemical cycles. Melack, J.M. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1984. 3p. NTIS, PC A04/MF A01.

In earth observing system, Volume 1, Part 2: science and mission requirements, A15-A17, N—84-30433 20-42.

The biosphere is the entire planetary system that includes, sustains and is influenced by life. The central issue of the science of the biosphere is the extent to which the Earth's surface, atmosphere and hydrosphere is the result of biological rather than abiotic processes. Space science and technology accelerates the understanding of global biological processes by providing repetive synoptic observations on large spatial scales once the relationships between the processes and the remotely sensed quantities are established. Especially promising applications of space technology are the measurement of biological productivity and portions of geochemical cycles in aquatic ecosystems and the evaluation and management of the quality of freshwater resources.

10394 (ORNL/TM—8910) Aspects of growth of Corbicula fluminea with supporting field and laboratory growth data. Mattice, J.S.; Wright, L.L. (Oak Ridge National Lab., TN (USA)). Jan 1985. Contract AC05-84OR21400. 62p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004776.

Environmental Sciences Division Publication No. 2427.

Studies of caged Asiatic clams (Corbicula fluminea) in Watts Bar Reservoir (Clinch River, Tennessee) indicate that interaction of intrinsic and extrinsic factors affects the rate of increase in shell length. Measurements of marked and unmarked clams were made at two sites with water temperatures differing by about 5°C in both 1976 and 1977, and at lower temperature sites in 1978 and early 1979. The growth season in Watts Bar began in April and continued through October. From November through March, growth virtually ceased. Increase in shell length was an inverse function of initial shell length; (i.e, small glams grew faster than larger ones). Rate of shell length increase differed between the two sites. Growth rate also varied during the growth season. Comparison of these rates for a single site during the year indicated that temperature plays a major role in growth rate determination. A decline in growth rate in spring, at about the time of peak reproduction, indicates that intrinsic factors are also important. Nevertheless, both laboratory and field studies suggest that the temperatures for optimum growth occur in the mid-20°C range. Because of this relationship between growth and temperature, estimates of both growth and life cycle length will vary depending on the natural annual temperature regime. Such differences could influence decisions regarding initiation of control procedures at industrial facilities. Tables of individual shell length measurements, calculated growth rates and statistical evaluations from laboratory and field tests are included in appendices to encourage comparison of this data with that collected in other temperature regimes. 33 references, 13 figures, 2 tables.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 5202009575, 9588, 9629, 10367, 10373, 10380, 10387, 10447

10395 (SNV-PM—1672) Determination of organic substance in industrial waste waters and testing of its degradability. Ladner, L.; Solyom, P. (Statens Naturvaardsverk, Stockholm (Sweden)). 1983. 75p. Statens Naturvaardsverk, Stockholm, Sweden.

This report presents one among several evaluating reviews of potential problem areas carried out within the SNV project area characterization of industrial waste waters. After a short theoretical background on the determination of organic substance in complex industrial waste waters, a review is given of the most used analytical methods for this purpose. Testing of degradability of the organic substance is discussed both in its historical perspective and in relation to present needs for accuracy and predictability of the consequences in natural water bodies. Based on established biodegradation tests for defined chemicals (OECD Guidelines); a proposal is given regarding necessary modifications of methods and principles for interpretation when dealing with complex industrial waste waters. Finally, a few proposals on future research needs are given.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 5203009622, 9624, 9626, 9627, 9628, 10380

10396 (AERE-R—11140) Review of the groundwater flow and radionuclide transport modelling in KBS-3. Atkinson, R.; Cherrill, T.P.; Herbert, A.W.; Hodgkinson, D.P.; Jackson, C.P.; Rae, J.; Robinson, P.C. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Jan 1984. 58p. HMSO, London, price Pound 6.00.

This report presents a review of the groundwater flow and radionuclide migration modelling performed for the recent Swedish KBS-3 safety study. General comments and suggestions are made on the methodology, assumptions and conceptual models used in the study. In addition, the three-dimensional groundwater flow calculations have been repeated and found to be in complete agreement with those performed for KBS-3. Some ways of making the groundwater flow calculations more realistic and more efficient have been investigated.

5204 Thermal Effluents Monitoring And Transport

10397 (PB—84-243443) Simple analytical model to predict the size of cooling-water plumes in a shallow lake. Sweers, H.E. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). 1984. 12p. NTIS, PC E03/MF E01.

Pub. in Kema Scientific and Technical Reports, v2 n3 p19-26 1984.

The extent and location of the cooling-water plume of Flevo power station (835 MWe) have been studied. The power station is situated on a small island in the IJsselmeer, a large (1200 sq km), shallow (4-5 m deep) and regularly shaped lake in the central-northern part of The Netherlands. The original (1969) plant capacity was 370 MWe; in 1974 the capacity was increased to 835 MWe.

The plume has been monitored 65 times. The mean area within the 3 K isotherm is 1300 sq m per MW discharged heat. It was found, however, that size and location of the plume vary greatly. Its location is well correlated with wind direction, but its size shows no obvious correlation with either strength or direction of the wind. The observed mean plume size has been compared with a calculated value, obtained by using a simple analytical model with mean values for the heat-exchange coefficient (42 W/sq m/K) and for the turbulent diffusion. The calculated value is in good accordance with the observed mean plume size.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 52050010409, 10439

5206 Regulations

REFER ALSO TO CITATION(S) 52060010383

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 5301009589, 10424

5302 Assessment Of Energy Technologies

10398 **(PB—84-237320) VOC emissions from volatile organic liquid storage tanks - background information for proposed standards. Draft environmental impact statement.** Farmer, J.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jul 1984. 267p. (EPA/450/3—81/003A). NTIS, PC A12/MF A01.

Standards of Performance for the control of VOC emissions from Volatile Organic Liquid (VOL) storage tanks are being proposed under the authority of Section 111 of the Clean Air Act. These standards would apply to all new and existing storage tanks having a capacity of 75 cubic meters or larger, which are to be used for the storage of VOL. This document contains background information and environmental and economic impact assessments of the regulatory alternatives considered in developing the proposed standards.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

REFER ALSO TO CITATION(S) 55020010430

10399 **(BNL—35475) Protein Data Bank.** Abola, E.E.; Bernstein, F.C.; Koetzle, T.F. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 6p. (CONF-8405260—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003610.

From Molecular dynamics workshop; Chapel Hill, NC, USA (14 May 1984).

The Protein Data Bank is the international depository for the results of structural studies of biological macromolecules. At present, some 1200 biological macromolecules are reported to have been crystallized, of which approximately 350 have structures determined to sufficient resolution that an atomic model has been generated. The Data Bank currently holds over 260 coordinate entries, with bibliographic entries for the remaining structures. For approximately one-third of the coordinate entries, associated structure factors are stored in the Bank. Most of the coordinate entries in the Bank are based directly on crystallographic studies. The Bank also includes a small number of model structures which have been generated either by theoretical analysis and computer simulation or by analogy with structures of chemically homologous molecules. Although the first structures deposited were proteins, we now distribute coordinates for DNA, tRNA, and polysaccharides as well. In quite a few instances, several data sets are held for a macromolecule obtained from different organisms, or in different states. 1 reference, 8 tables. (ACR)

10400 **(BNL—35577) Modulation of light energy transduction in photosynthesis.** Bennett, J. (Brookhaven National Lab., Upton, NY (USA)). Jul 1984. Contract AC02-76CH00016. 9p. (CONF-840783—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004711.

From 9. international congress on photobiology; Philadelphia, PA, USA (3 Jul 1984).

The symposium on modulation of light energy transduction in photosynthesis is summarized. Specific topics discussed include: longer term modulation of light energy transduction; the photoinhibition of photosystem 2 activity in plants exposed to high light intensities; the molecular basis of chilling sensitivity in plants; and the adaptation of cyanobacteria to changes in light quality. (MF)

10401 **(LBL—18649) Conformational studies of nucleic acids.** Pearlman, D.A. (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 363p. NTIS, PC A16/MF A01; GPO Dep. File Number DE85003843.

Thesis.

Techniques are developed for thorough examinations of the conformational energetics of nucleic acids and their constituents. The first one is a method for modeling the furanose sugar ring in nucleic acids. This method allows the coordinates corresponding to any sugar conformation to be generated rapidly and unambiguously from just the phase angle of pseudorotation. Taking advantage of this simplification, we carry out the first calculations to completely explore the conformational spaces available to the eight commonly occurring nucleosides using experimentally consistent furanose geometries and an appropriate classical potential energy force field. Results are in excellent agreement with experiment. We also develop empirically fit multiple correlation functions between the torsion angles of nucleic acids. This reduces the number of conformations which need to be considered in a thorough energetic survey for a nucleic acid. Such surveys are then carried out for two single-stranded nucleic acid tetramers: d(ApApApA) and ApApApA. We create energy contour maps for each of the 21 possible torsion angle pairs in a nucleotide repeating unit. The maps are quite consistent with the experimental distribution of oligonucleotide data and provide rationalizations for several experimentally observed angle-angle correlations. Complete energy minimization is carried out on all local minima found in the surveys. Both the maps and minimizations indicate DNA and RNA to be highly polymorphic. Conformational changes in DNA upon damage by uv radiation are also studied using energy minimization techniques. Finally, we derive a set of partial charges for a nucleotide (2'-deoxycytidine 5'-monophosphate monohydrate) from high resolution x-ray data.

10402 **(LBL—18691) Biophysical bases of human plasma lipoprotein polydispersity: role of surface modification.** Shahrokh, Z. (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 298p. NTIS, PC A13/MF A01; GPO Dep. File Number DE85005155.

Thesis.

Metabolic depletion of the core of the triglyceride-rich lipoproteins via lipolysis results in the production of polydisperse species of particles within the density range of low density lipoproteins (LDL). Modifications of surface properties of plasma LDL may further contribute to LDL polydispersity. In this dissertation, we study the interactions with LDL of models of lipolysis-related surface products (i.e., phosphatidylcholine vesicles (PCV) and discoidal complexes (DC) of apoprotein AI and phosphatidylcholine) and examine the influence on such interactions of high density lipoproteins (HDL) and other relevant plasma components (lecithin:cholesterol acyltransferase (LCAT), lipid transfer proteins (LTPs), albumin, lysolecithin (LPC)). Based on the studies obtained in this dissertation LDL surface modification may contribute to LDL polydispersity. Since HDL is a major acceptor of PL, formation of surface-modified LDL (e.g., PL-enriched, larged LDL) in

vivo would depend on LDL/HDL weight ratio in plasma. 140 references, 50 figures, 15 tables.

5505 Metabolism

10403 **(LBL—18628) Study of cultured fibroblasts in vivo using NMR.** Karczmar, G.S. (Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 172p. NTIS, PC A08/MF A01; GPO Dep. File Number DE85004604.

Thesis.

The goal was to study the compartmentation of phosphorylated glycolytic intermediates in intact Chicken Embryo Fibroblasts (CEFs) using ^{31}P NMR at 109 MHz. A technique for maintaining functional cells at high densities in an NMR magnet is described. Signals were detected from cytoplasmic inorganic phosphate (P/sub i/), ATP, NAD, NADH, phosphorylcholine and phosphorylethanolamine. The effect of external glucose on cytoplasmic pools of phosphates was studied. When cells were perfused with glucose-free medium the rate of glycolysis decreased, the amplitudes of the ATP resonances decreased, and the P/sub i/ intensity increased. The quantity of NMR-detectable P/sub i/ produced was significantly greater than the quantity of NMR-detectable ATP which was lost. Experiments with ^{32}P labeled P/sub i/ showed that as the concentration of glucose in the medium was increase, the amount of phosphate sequestered in the cells increased. We conclude that there is a pool of P/sub i/ which is not detected by high resolution NMR and that the size of this pool increases as the rate of glycolysis increase. Longtitudinal relaxation times of intracellular phosphates in normal, transformed, and primary CEFs were measured. The results demonstrate that relaxation times of phosphates are sensitive to structural and metabolic changes which occur when cells are grown in culture. 59 references. 31 figures.

5506 Medicine

10404 **(TRI-PP—84-93) Rapid transfer of short-lived radioisotopes via a 2.4 km rabbit system.** Burgerjon, J.J.; Gelbart, Z.; Lau, V.; Lehnart, D.; Lenz, J.; Pate, B.D.; Ruth, T.J.; Sprenger, H.P.; van Oers, N.S.C. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility). Sep 1984. 10p. (CONF-840916—6). NTIS (US Sales Only), PC A02/MF A01. File Number DE85900435.

From Robotics and remote handling in the nuclear industry conference; Toronto, Ontario, Canada (23 Sep 1984).

A 2.4 km long pipeline between a cyclotron and a hospital is used for the rapid transfer of short-lived radiopharmaceuticals. The vials containing the pharmaceuticals are placed inside capsules (rabbits) that are blown through a tube by means of compressed air. Travel times as short as 2 min are achieved, which makes the system suitable for the transfer of ^{15}O, which has a 2 min half-life. The construction and test results of the system are described along with a computer model, developed to explain some properties of the system. 7 references, 15 figures, 2 tables.

10405 **A local field study of a water-immersed microwave antenna array for medical imagery and therapy.** Gou, T.C.; Guo, W.W.; Larsen, L.E. (John Hopkins University Applied Physics Laboratory, Laurel, MD 20707). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Microwave Theory and Techniques;* **MTT-32**: No. 8, 844-854(Aug 1984).

A water-immersed microwave array system for medical imaging is described, and a theoretical analysis of its local field pattern is presented. The theoretical study also applies to similar systems for medical therapy purposes. It is shown that, using a technique of phase and amplitude conjugations, a satisfactory three-dimensional focusing for targets located in the neighborhood of the array may be achieved. The focusing resolutions for transverse and longitudinal directions are approximately $\lambda/2$ and λ, respectively, where λ is the wavelength in the dielectric. By increasing the element spacing of the array, the resolutions can be as good as 5.3 and 11.7 mm, respectively, at the operating frequency of 3 GHz.

10406 **New directions in NMR imaging.** Lauterbur, P.C. (Department of Chemistry, State University of New York at Stony Brook, Stony Brook, New York 11794). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-31**: No. 4, 1010(Aug 1984).

Spectroscopic NMR imaging, microscopic NMR imaging, and the NMR imaging of gases are under development and may have significant applications in biomedical research and clinical investigations.

10407 **Electronics and instrumentation for NMR imaging.** Maudsley, A.A.; Hilal, S.K.; Simon, H.E. (Advanced NMR Systems, Inc., 400 W. Cummings Park, Woburn, MA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-31**: No. 4, 990-993(Aug 1984).

The development of Nuclear Magnetic Resonance (NMR) imaging has brought together the experimental techniques of NMR spectroscopy and image processing with the consequence that new experimental requirements and apparatus are currently being developed. Examples of these requirements include the large amounts of data which can be generated and the effect on data processing and storage requirements. Also, the increased size of objects under investigation necessitate some major changes in the magnet and R.F. system. A discussion of these specific requirements is presented together with an overview of all components of the NMR imaging system.

5507 Microbiology

REFER ALSO TO CITATION(S) 5507009651

5509 Pathology

10408 **(LBL—18619) Epidemiology of ovarian cancer in the United States: an ecological analysis.** Pinto, J.A. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004899.

There were 111,037 deaths attributed to ovarian cancer in women over age 35 (white = 102,668; non-white = 8369) in the United States during the eleven year period 1968 to 1978. Ecological analysis of several hypothesized risk factors used trditional regression analysis and an alternative method which orders the population on the basis of some predictor variable of interest and partitions it into a series of equal risk categories which can then be analyzed for associations. Both methods showed birthrate in 1940 and access to medical care to be predictive of ovarian cancer mortality in United States counties in 1970. Ovarian cancer mortality showed no consistent geographic pattern when viewed by traditional computer mapping techniques, with the high rate counties scattered randomly throughout the country. However, when the country was divided into equal risk categories by latitude, longitude, and a latitudinal/longitudinal index representing distance from the center of the United States, it was found that there were significantly higher rates in the central states as compared to the border states. This study demonstrates the application of alternative techniques of ecological analysis of a large mortality database, and illustrates the value of division of the population into equal risk categories to control for a potential confounder in the analysis of geographic patterns. 10 figures, 9 tables.

5520 Public Health

REFER ALSO TO CITATION(S) 55200010408

5530 Agriculture And Food Technology

10409 **(NP—5900439) Use of the white amur for aquatic plant management. Final report.** Miller, A.C.; Decell, J.L. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab.). Aug 1984. 52p. NTIS, PC A04/MF A01. File Number TI85900439.

The manual presents practical guidelines for the use of the white amur to manage aquatic vegetation in lakes and ponds. This document will introduce the reader to the white amur as a biological control agent for submersed aquatic plants, and present information necessary for successful use of the fish. Included are methods for calculating the number of fish required to effect a desired level of plant control, as well as information on obtaining, shipping, and releasing white amur. Data on feeding, growth rates, food preferences, reproduction, and tolerances to various aquatic conditions are also presented. Case studies on the use of the fish are discussed to illustrate possible impacts of white amur on water chemistry and native biota. While the majority of the information for this report originated in Lake Conway, Florida, the fish is a viable control agent in other parts of the country. This manual should have utility in all parts of the United States in providing background data on the white amur and concise information on the proper use of fish to control submersed aquatic plants. 122 references.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 56011010412

10410 **(CONF-8409191—1) Role of repair processes in neoplastic transformation induced by ionizing radiation in C3H/10T1/2 cells.** Hill, C.K.; Elkind, M.M.; Han, A. (Argonne National Lab., IL (USA); Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology; University of Southern California, Los Angeles (USA). School of Medicine). 1984. Contract W-31-109-ENG-38. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002746.

From Cell transformation assays conference; Research Triangle Park, NC, USA (11 Sep 1984).

The paper discusses the mechanisms underlying the induction and modulation of neoplastic transformation by the type and mode of radiation delivery. Those features of transformation in vitro characteristic of induction by ionizing radiation are described. 33 references, 10 figures. (ACR)

10411 **(LA—10246-MS) Uranium internal exposure evaluation based on urine assay data.** Lawrence, J.N.P. (Los Alamos National Lab., NM (USA)). Sep 1984. Contract W-7405-ENG-36. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005230.

The difficulties in assessing internal exposures to uranium from urine assay data are described. A simplified application of the ICRP-30 and ICRP Lung Model concepts to the estimation of uranium intake is presented. A discussion follows on the development of a computer code utilizing the ICRP-30-based uranium elimination model with the existing urine assay information. The calculated uranium exposures from 1949 through 1983 are discussed. 13 references, 1 table.

10412 **(LBL—18148) NMR imaging and spectroscopy of the mammalian central nervous system after heavy ion radiation.** Richards, T. (Lawrence Berkeley Lab., CA (USA)). Sep 1984. Contract AC03-76SF00098. 242p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85004509.

NMR imaging, NMR spectroscopic, and histopathologic techniques were used to study the proton relaxation time and related biochemical changes in the central nervous system after helium beam in vivo irradiation of the rodent brain. The spectroscopic observations reported in this dissertation were made possible by development of methods for measuring the NMR parameters of the rodent brain in vivo and in vitro. The methods include (1) depth selective spectroscopy using an optimization of rf pulse energy based on a priori knowledge of N-acetyl aspartate and lipid spectra of the normal brain, (2) phase-encoded proton spectroscopy of the living rodent using a surface coil, and (3) dual aqueous and organic tissue extraction technique for spectroscopy. Radiation induced increases were observed in lipid and p-choline peaks of the proton spectrum, in vivo. Proton NMR spectroscopy measurements on brain extracts (aqueous and organic solvents) were made to observe chemical changes that could not be seen in vivo. Radiation-induced changes were observed in lactate, GABA, glutamate, and p-choline peak areas of the aqueous fraction spectra. In the organic fraction, decreases were observed in peak area ratios of the terminal-methyl peaks, the N-methyl groups of choline, and at a peak at 2.84 ppM (phosphatidyl ethanolamine and phosphatidyl serine resonances) relative to TMS. With histology and Evans blue injections, blood-brain barrier alternations were seen as early as 4 days after irradiation. 83 references, 53 figures.

10413 **(LBL—18303) Ionizing and ultraviolet radiation enhances the efficiency of DNA mediated gene transfer in vitro.** Perez, C.F. (Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 237p. NTIS, PC A11/MF A01; GPO Dep. File Number DE85004896.

Thesis.

The enhancement effects of ionizing and non-ionizing radiation on the efficiency of DNA mediated gene transfer were studied. Confluent Rat-2 cells were transfected with purified SV40 viral DNA, irradiated with either X-rays or ultraviolet, trypsinized, plated, and assayed for the formation of foci on Rat-2 monolayers. Both ionizing and ultraviolet radiation enhanced the frequency of A-gene transformants/survivor compared to unirradiated transfected cells. These enhancements were non-linear and dose dependent. A recombinant plasmid, pOT-TK5, was constructed that contained the SV40 virus A-gene and the Herpes Simplex virus (HSV) thymidine kinase (TK) gene. Confluent Rat-2 cells transfected with pOT-TK5 DNA and then immediately irradiated with either X-rays or 330 MeV/amu argon particles at the Berkeley Bevalac showed a higher frequency of HAT^+ colonies/survivor than unirradiated transfected cells. Rat-2 cells transfected with the plasmid, pTK2, containing only the HSV TK-gene were enhanced for TK-transformation by both X-rays and ultraviolet radiation. The results demonstrate that radiation enhancement of the efficiency of DNA mediated gene transfer is not explained by increased nuclear uptake of the transfected DNA. Radiation increases the competence of the transfected cell population for genetic transformation. Three models for this increased competence are presented. The targeted integration model, the inducible recombination model, the partition model, and the utilization of DNA mediated gene transfer for DNA repair studies are discussed. 465 references.

10414 **(ORNL—6077) Environmental and Occupational Safety Division annual progress report for 1983.** (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004812.

This report presents summaries of activities conducted during 1983 in the following areas: radiation monitoring; health physics instrumentation development; environmental management; atmospheric monitoring; water monitoring; background radiation measurements; soil and grass samples; deer samples; calculation of potential radiation dose to the public; industrial safety; and operational safety. (ACR)

10415 **(RFP—3602) Annual report of radiation exposures to Rockwell employees at the Rocky Flats Plant - 1982.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1 Jun 1983. Contract AC04-76DP03533. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003971.

This report presents radiation exposure data through 1982 for both internal and external exposures. 1982 results are highlight-

ed and compared to past results. Acceptable trends were noted in 1982 for all categories of radiation exposure except contaminated wounds. 12 figures, 3 tables.

10416 **Influence of radon daughter exposure rate, unattachment fraction, and disequilibrium on occurrence of lung tumours.** Cross, F.T.; Palmer, R.F.; Dagle, G.E.; Busch, R.H.; Buschbom, R.L. (Pacific Northwest Lab., Richland, WA (USA)). *Radiation Protection Dosimetry;* 7: No. 1-4, 381-384(1984). (CONF-831049—).

From International seminar on indoor exposure to natural radiation and related risk assessment; Capri, Italy (3 Oct 1983).

Groups of male, specific-pathogen-free (SPF), Wistar rats were exposed to several concentrations of radon daughters and uranium ore dust to clarify the roles of exposure rate, unattached RaA daughters, and the degree of radon daughter disequilibrium, in the development of respiratory system disease. Modelled, human dosimetric data indicate that the dose to sensitive tissues of the respiratory tract increases with increasing radon daughter unattachment fraction and degree of disequilibrium. Data bearing on these developments as well as updated results of experiments designed to test the role of radon daughter exposure rate on lung tumour incidence are reported.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 5603009433, 9504, 9505, 9553, 9554, 9959

10417 **(LA—10214-T) Comparison of two lung clearance models based on the dissolution rates of oxidized depleted uranium.** Crist, K.C. (Los Alamos National Lab., NM (USA)). Oct 1984. Contract W-7405-ENG-36. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85005190.

An in-vitro dissolution study was conducted on two respirable oxidized depleted uranium samples. The dissolution rates generated from this study were then utilized in the International Commission on Radiological Protection Task Group lung clearance model and a lung clearance model proposed by Cuddihy. Predictions from both models based on the dissolution rates of the amount of oxidized depleted uranium that would be cleared to blood from the pulmonary region following an inhalation exposure were compared. It was found that the predictions made by both models differed considerably. The difference between the predictions was attributed to the differences in the way each model perceives the clearance from the pulmonary region. 33 references, 11 figures, 9 tables.

10418 **(LBL—17218) Electron microscopic investigations of lung cell response to particulate insult.** Finch, G.L. (Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 195p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85004605.

Thesis.

The studies described herein provide quantitative morphological characterizations of the interactions between respirably-sized particles and lung tissues and cells. The differential effects of toxic versus nontoxic particulate materials administered at low doses and short time periods were examined. In vivo experiments on BALB/c mice investigated the pulmonary effects, clearance, and redistribution of intratracheally instilled Ni_3S_2 versus TiO_2. Quantitative scanning electron microscopic (SEM) techniques were used to evaluate the effects of Ni_3S_2 on hamster tracheal explant sections maintained in tissue culture. The clearance of particles from the lumenal surface was also described. In vitro experiments were conducted on lavaged, cultured bovine alveolar macrophage cells (AM) exposed to Ni_3S_2, TiO_2, and glass beads (GB). Correlative techniques were employed which permitted the examination of individual particle-exposed AM by vital dye staining light microscopy to determine viability, quantitative SEM to evaluate cell morphology and particle content, and whole cell mount transmission electron microscopy (TEM) to visualize AM internal ultrastructure. Quantitative examinations demonstrated that Ni_3S_2 and TiO_2, but not GB, particle content was correlated with AM alteration, and that Ni_3S_2 and TiO_2 internalization was correlated with cell death. 74 references, 35 figures, 18 tables.

10419 **(N—84-33015) Comparative study in the animal of the toxicity of the combustion products of diverse materials.** Delcroix, J.P.; Guerbet, M. (Laboratoire Central de Biologie Aerospatiale, 75 - Paris (France)). May 1984. 14p. (In French). NTIS, PC A05/MF A01.

In AGARD occupational med. relevant to aviation med., 14 p, N—84-33011 22-52.

Materials with minimal toxicity must be chosen in case of fire in an enclosed space and, more particularly, onboard aircraft. An analytical study of atmospheric products is not sufficient for evaluating the risks encountered. There must be experimentation with animals. A methodology was created which associates an original model fire and a protocol for exposing animals to toxic gas products in order to study the response to aggression of the entire organism with its susceptabilities and reactions. Objective toxicological criteria are proposed with a view towards establishing a classification of materials according to chosen danger criteria.

10420 **(PB—84-242122) Effects of acid rain on plant microbial associations in California. Research report (final).** Harris, D.; Paul, E.A. (California Univ., Berkeley (USA)). 13 Apr 1984. 69p. NTIS, PC A04/MF A01.

The effects of simulated acid rain of pH 5.6 to 3.0, with ionic composition similar to that found in California, on Trifolium repens, Lupinus densiflorus and L. benthamii grown in two soils were tested. The interactions of treatment intensity, soil type, phosphorus uptake and mycorrhizal influences on growth, carbon fixation and allocation and nitrogen fixation were determined. Acidic treatments generally decreased plant growth, nodulation and nitrogenase activity. The exposure of plants to a large number of simulated rainfall conditions of shorter duration did not result in the negative growth effects. Plants adequately supplied with P, either as fertilizer or by mycorrhizal fungi, were much more resistant to conditions caused by acidic precipitation and in some cases growth increases were found.

10421 **(PNL-SA—12427) Comparative solubility and acute toxicity to Daphnia magna of coal liquids, shale oil and petroleum.** Gray, R.H.; Dauble, D.D.; Scott, A.J.; Thomas, B.L. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 13p. (CONF-8411123—1). NTIS, PC A02/F A01; GPO Dep. File Number DE85003637.

From 11. annual aquatic toxicity workshop; Vancouver, Canada (13 Nov 1984).

Evaluating toxicity of complex organic mixtures to aquatic biota involves generating and characterizing water-soluble fractions (WSF) of test materials. Depending on the mixture, WSFs may contain several biologically active compound classes including phenolics, aromatic and saturate hydrocarbons, aromatic amines, sulfur heterocycles and others. Although some components (e.g. phenolics) may predominate, each contributes to overall toxicity. We studied the relationships among solubility, chemical composition and acute toxicity of several fossil-derived materials. These included coal liquids with different boiling ranges, coal liquids produced by different technological processes and under different process conditions, coal liquids derived from different source coals, a shale oil and, crude and refined petroleum. Results indicated that concentrations of water-soluble components varied with component solubility and chemical composition of parent material, provided that mixing conditions were similar. Acute toxicity to Daphnia magna reflected solubility of chemical components and, in most cases, could be predicted from concentrations of total carbon in solution. Coal liquids were generally more soluble in water than shale oil and petroleum materials and, thus, posed a greater potential toxic hazard to aquatic biota. Lower boiling range coal liquids were most soluble, and thus, posed the greatest acute hazard in water. Coal type had little influence on acute toxicity of coal liquid WSFs to D. magna. 20 references, 1 figure, 1 table.

10422 (STUB—12) Viability of various weed seeds in anaerobic conditions (biogas plant). Hansen, S.; Hansen, J. (STUB Samarbejdsgruppen for Teknologisk Udvikling af Biogas, Glostrup (Denmark)). Apr 1983. 22p. (In Danish). STUB Samarbejdsgruppen for Teknologisk Udvikling af Biogas, Glostrup, Denmark. File Number TI85750127.

EFP.

Seeds from different weeds, Urtica urens L. (nettle), Solanum nigrum L. (nightshade), Avena fatua L. (wild oat-grass), Brassica napus L. (rape), Chenopodium album L. (goose-foot), were put into small polyester net bags, which were placed in biogas reactors containing cattle manure. These "biogas reactors" were placed at different temperatures . Net bags were taken out after 4.5, 10.5, 21.5, 38 and 53 days, and the seeds were tested for their viability by germination tests and the tetrazolium method. Concerning all seeds it was manifested that the viability decreased very steeply at 35degC. Most of the seeds had a T_{50} at 2-5 days; Chenopodium album L seeds had a T_{50} at 16 days. After 4.5 days it was not possible to find living Avena fatua L seeds. The decrease in viability was less steep at 20degC and even less steep at 2degC.

10423 (SVC—83-37) Toxic metals in the outdoor environment. Stern, R.M. (Svejsecentralen, Glostrup (Denmark)). 1983. 38p. (CONF-831295—1). Svejsecentralen, Glostrup, Denmark. File Number TI85750115.

From 6. industrial hygiene convention; Rome, Italy (5 Dec 1983).

Exposure to the toxic trace metals is discussed in terms of welding fumes and fly ash as examples to particulate aerosols which contribute a wide range of elements to the indoor (working) and outdoor (general) environments. Many of these metal ions are essential to human metabolism. Their toxicity is controlled by a wide range of mechanisms making a prior assessment of the health risk which results from long term exposure at low levels difficult. The results of a large number of epidemiological studies of lung cancer incidence among welders show that general occupational exposure to metals, many of which are mutagenic, does not result in an apparent overincidence of lung cancer, with one exception: Preliminary evidence indicates that welders of stainless steel are at relatively high excess lung cancer risk, possibly because their exposure to Cr(VI) in welding fumes is comparable to the Cr(VI) exposure of workers in the chromate industry, for whom a similar risk has been documented.

10424 National Crop Loss Assessment Network (NCLAN): an interdisciplinary approach to assessment of the economic impact of air pollution on agriculture. Preston, E.M. Pittsburgh, PA, USA; Air Pollution Control Association (1982). 13p. (CONF-820627—Pt.8).

From 75. annual meeting of the Air Pollution Control Association; New Orleans, LA, USA (20 Jun 1982).

10425 Skin carcinogenesis studies of emission extracts. Nesnow, S.; Evans, C.; Stead, A.; Creason, J.; Slaga, T.J.; Triplett, L.L. (Environmental Protection Agency, Research Triangle Park, NC). *Developments in Toxicology and Environmental Science;* **10**: 295-320(1982). (CONF-8110252—). Contract W-7405-ENG-26.

From EPA diesel emissions symposium; Raleigh, NC, USA (5 Oct 1981).

The incomplete combustion of fossil fuels results in the emission of particulate and organic vapor-phase components to the atmosphere. The particulate phase of these emissions contains organic materials adsorbed onto the particulate matrix. The SENCAR mouse has been shown to be highly sensitive in carcinogens and useful in mechanistic studies of carcinogenesis. The results are described of a systematic study of the ability of extracts of particulate emissions to induce benign and malignant tumors in SENCAR mice and their abilities to act as tumor initiators, tumor promoters, or complete carcinogens.

10426 Inhalation toxicology of diesel exhaust particles. McClellan, R.O.; Brooks, A.L.; Cuddihy, R.G.; Jones, R.K.; Mauderly, J.L.; Wolff, R.K. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Developments in Toxicology and Environmental Science;* **10**: 99-120(1982). (CONF-8110252—).

From EPA diesel emissions symposium; Raleigh, NC, USA (5 Oct 1981).

Increased concern has developed in recent years for the potential health effects to man from exposure to diesel exhaust. This concern stems from recognition that (a) diesel exhaust particles are small in size, readily inhaled and deposited throughout the respiratory tract, (b) the relatively insoluble carbonaceous core of the particles results in their retention in the lungs, and (c) the cytotoxic and mutagenic properties of the particles may result in diseases of the lungs. Experimental studies on the deposition and retention of diesel exhaust particles are reviewed. There is morphological and biochemical evidence of lung tissue injury and adaptation or repair after inhalation of very high levels of the exhaust, but the longest term studies have not demonstrated carcinogenicity or major physiological changes. Some areas requiring further research are identified.

10427 Human cell mutagenicity of polycyclic aromatic hydrocarbon components of diesel emissions. Barfknecht, T.R.; Hites, R.A.; Cavaliers, E.L.; Thilly, W.G. (Massachusetts Inst. of Tech., Cambridge). *Developments in Toxicology and Environmental Science;* **10**: 277-294(1982). (CONF-8110252—). Contract AC02-77EV04267;AC02-80EV10449.

From EPA diesel emissions symposium; Raleigh, NC, USA (5 Oct 1981).

In an earlier report, it was shown that a methylene chloride extract of automobile diesel exhaust particulate was significantly mutagenic to both Salmonella typhimurium and diploid human lymphoblasts in the concentration range of 50-100 μg/ml when treatment was in conjunction with an Aroclor-induced rat liver microsome-containing postmitochondrial supernatant (PMS). This diesel exhaust particulate extract also contained direct-acting mutagens for S. typhimurium. However, no direct-acting mutagenic activity was detected by the human lymphoblast mutation assay. Fractionation of the methylene chloride extract was performed and the seven resultant fractions were tested for their mutation inducing ability in the S. typhimurium 8-azaguanine resistance forward mutation assay, with and without rat liver PMS. A hexane/toluene fraction, which represents 6.5% by weight of the total methylene chloride extract, contained the polycyclic aromatic hydrocarbons (PAH) and was found to be the most mutagenic fraction to S. typhimurium with PMS activation. Although others have reported that organic extracts of diesel exhaust particulate from various sources contain direct-acting mutagens for mammalian cells, an emphasis has been placed upon determining what PAH may be responsible for the mutagenicity of diesel exhaust particulate extract to human lymphoblasts. In addition, studies have been conducted to determine the mutagenicity of PAH and their derivatives that are found in other organic extracts of emissions collected from diesel engines.

10428 Potential health risks from increased use of diesel light duty vehicles. Cuddihy, R.G.; McClellan, R.O.; Griffith, W.C.; Seiler, F.A.; Scott, B.R. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Developments in Toxicology and Environmental Science;* **10**: 353-367(1982). (CONF-8110252—). Contract AC04-76EV01013.

From EPA diesel emissions symposium; Raleigh, NC, USA (5 Oct 1981).

The potential health risks for people who may be exposed to increased levels of diesel light duty vehicle emissions in the future are generally expected to be similar to the risks from exposures to other combustion products in the atmosphere. They include risks of developing respiratory functional diseases, cancers of the respiratory tract and cancers of other organs. Extensive toxicology research programs are currently attempting to determine if light duty diesel vehicle emissions have physical or chemical properties that would make them significantly more toxic than other combustion products in the environment. To date, however, no unique compounds have been identified in diesel emissions that add substantial new concerns to those already raised by existing levels of these pollutants in urban air. Therefore, an attempt is made to identify the potential contribution of future light duty diesel vehicle emissions to existing atmospheric pollutant levels and to estimate an upper limit for their potential health risks. Atmospheric concentrations of particles emitted by diesel vehicles were projected for major cities in the US using a computerized atmospheric dispersion model.

5604 Other Environmental Pollutant Effects

10429 (AD-A—144305/0) Bioelectromagnetics research in France--an assessment. Technical report. Rozzell, T.C. (Office of Naval Research (USA). London Branch Office). 29 Jun 1984. 14p. (ONRL-R—8-84). NTIS, PC A02/MF A01.

Over the past decade, France has played a major research role in bioelectromagnetics (BEM) (studies of the interaction of electromagnetic fields with biological systems). While the total French program was moderate compared with those of other countries, the contributions it made were highly significant and had an impact on almost every area of the field. This report examines recently completed BEM research and discusses some work done over the past 3 to 5 years.

10430 (DOE/EV/02217—46) Investigation of molecular mechanisms in photodynamic action and radiobiology with nanosecond flash photolysis and pulse radiolysis. Progress report, 1982. Grossweiner, L.I. (Illinois Inst. of Tech., Chicago (USA)). 1983. Contract AC02-76EV02217. 23p. (COO—2217-46). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004290.

Liposomes have been employed as membrane models applicable to photosensitization in phototherapy procedures. The results with 8-methoxypsoralen, the sensitizer in PUVA therapy of psoriasis, show that singlet oxygen generated by near-uv (uv-A) irradiation induces membrane damage leading to lysis. A similar role of singlet oxygen has been shown for photosensitization of liposomes by methylene blue, with the new observation that hydrodynamic forces promote the lytic action initiated by singlet oxygen attack on an unsaturated site of phosphatidylcholine. Liposome photosensitization by hematoporphyrin follows a Type II mechanism mediated by singlet oxygen for low sensitizer concentrations, and a Type I, anoxic, mechanism when the hematoporphyrin is aggregated. Similar concentration effects obtain with hematoporphyrin derivative (hpd), the photosensitizer in photoradiation therapy of malignant tumors. Studies on the components of hpd separated by gel chromatography show that the putative biological active fraction can photosensitize membrane damage under oxic and anoxic conditions. The oxic pathway was suppressed by binding to human serum albumin, as involved in serum transport of hpd prior to localization in tumor tissue. A study on hematoporphyrin photosensitization of targets other than membranes has shown that singlet oxygen is responsible for the photosensitized inactivation of subtilisin BPN' and photooxidation of tryptophan in human and bovine serum albumin. In the case of the serum proteins, the singlet oxygen is generated by the sensitizer-protein complex and it may react with all protein in the system. 11 references.

10431 Effects of 2450-MHz microwave energy on the blood-brain barrier: An overview and critique of past and present research. Williams, W.W.; Cerro, M.; Hoss, W.; Lu, S.; Michaelson, S.M. (Department of Neurology, University of Rochester Medical Center, Rochester, NY 14642). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Microwave Theory and Techniques;* MTT-32: No. 8, 808-818(Aug 1984).

The dynamics and complexity of the blood-brain barrier (BBB) make it a very difficult system for study. The variety of techniques employed to assess microwave effects on the barrier all appear subject to limitations in either sensitivity or applicability. Inconsistencies in tracer characteristics, experimental design, and in the microwave parameters employed, i.e., microwave system used (pulsed or continuous wave), field orientation relative to the exposed animal, frequency, power density, and duration of exposure, anesthesia or physical restraint, all have lead to difficulties in interpreting results and replication of experiments. Therefore, the technical approach, as well as data obtained, must be carefully scrutinized to avoid misinterpretation of results that may lead to erroneous conclusions. Recent studies by Williams et al. have endeavored to consolidate various technical approaches within a single study in order to more clearly interpret potential microwave-blood-brain barrier interactions and to minimize extraneous factors which may confound these effects. The authors' findings, as well as those of other investigators fail to confirm previously published reports of increased blood-brain barrier permeability in rats following exposure to microwaves. These findings, however, support the conclusion that suppression of BBB permeability occurs, and that this effect is mediated by temperature-dependent changes in endothelial cell function, and not by qualities unique to microwave energy.

10432 Exposure of human mononuclear leukocytes to microwave energy pulse modulated at 16 or 60 Hz. Roberts, N.J.; Lu, S.; Michaelson, S.M. (Department of Medicine University of Rochester School of Medicine, Rochester, NY 14642). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Microwave Theory and Techniques;* MTT-32: No. 8, 803-807(Aug 1984).

Human mononuclear leukocytes were exposed to 2450-MHz microwaves pulse modulated at 16 or 60 Hz, at specific absorption rates up to 4 mW/ml. Such exposures produced no detectable effects on leukocyte viability, or on unstimulated or mitogen-stimulated DNA synthesis or total protein synthesis. The data provided no evidence that exposure to pulse modulated microwaves is more likely to alter human leukocyte function than is exposure to continuous waves at equivalent energy levels.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 57000010414

10433 (RFP—3743) Rockwell International - Rocky Flats Plant: Occupational Health Information System. Bistine, R.W.; Petrocchi, A.; Wright, W.L.; Yoder, R.E.; Fischer, C.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1984. Contract AC04-76DP03533. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005179.

The Rockwell International-Rocky Flats Occupational Health Information System uses the FLOW GEMINI software on a VAX computer system. The system is extremely user friendly, flexible, comprehensive, and easily customized by the user. The system contains the editioned files (i.e., time organized historical data) of the Medical, Industrial Hygiene, Health Physics, and Safety Departments. It maintains, analyzes and reports on data from employee medical and work histories, medical exams, workplace monitoring, and health effects related to specific hazards or locations in the workplace. It identifies and reports potential individual and group problems through regular reports and responses to online queries. In addition, it schedules examination, sampling, produces standard user-defined reports, and provides statistical analysis capabilities. The system presently contains a file of more than 20,000 Material Data Safety Sheets. A user group provides a mechanism for sharing ideas and continual software enhancement. 11 figures.

58 GEOSCIENCES

5801 Geology And Hydrology

10434 (LBL—17449) Hydrologic behavior of fracture networks. Long, J.C.S.; Endo, H.K.; Karasaki, K.; Pyrak, L.; MacLean, P.; Witherspoon, P.A. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 16p. (CONF-850101—2). NTIS, PC A02. File Number DE85004654.

From International congress on hydrology of rocks of low permeability; Tucson, AZ, USA (7 Jan 1985).

This paper reviews recent research on the nature of flow and transport in discontinuous fracture networks. The hydrologic behavior of these networks has been examined using two- and three-dimensional numerical models. The numerical models represent random realizations of fracture networks based on statistical field measurements of fracture geometry and equivalent hydraulic aperture. We have compared the flux and mechanical transport behavior of these networks to the behavior of equivalent continua. In this way we are able to determine whether a given fracture network can be modeled as an equivalent porous media in both flux

and advective transport studies. We have examined departures from porous media behavior both as a function of interconnectivity and heterogeneity. Parameter studies have revealed behavior patterns such as: given a fracture frequency that can be measured in the field, porous media like behavior and the magnitude of permeability are both enhanced if the fractures are longer and the standard deviation of fracture permeabilities is smaller. Transport studies have shown that the ratio between flux and velocity is not necessarily constant when the direction of flow is changed in systems which do behave like a porous media for flux. Thus the conditions under which porous media analysis can be used in transport studies are more restrictive than the condition for flux studies. We have examined systems which do not behave like porous media and have shown how the in situ behavior varies as a function of scale of observation. The behavior of well tests in fractured networks has been modeled and compared to a new analytical well test solution which accounts for the early time dominance of the fractures intersecting the well. Finally, a three-dimensional fracture flow model has been constructed which assumes fractures are randomly located discs. 13 references, 12 figures.

10435 **(LBL—17490) Modeling of strongly heat-driven flow in partially saturated fractured porous media.** Pruess, K.; Tsang, Y.W.; Wang, J.S.Y. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 15p. (CONF-850101—3). NTIS, PC A02. File Number DE85004660.

From International congress on hydrology of rocks of low permeability; Tucson, AZ, USA (7 Jan 1985).

We have performed modeling studies on the simultaneous transport of heat, liquid water, vapor, and air in partially saturated fractured porous media, with particular emphasis on strongly heat-driven flow. The presence of fractures makes the transport problem very complex, both in terms of flow geometry and physics. The numerical simulator used for our flow calculations takes into account most of the physical effects which are important in multi-phase fluid and heat flow. It has provisions to handle the extreme nonlinearities which arise in phase transitions, component disappearances, and capillary discontinuities at fracture faces. We model a region around an infinite linear string of nuclear waste canisters, taking into account both the discrete fractures and the porous matrix. From an analysis of the results obtained with explicit fractures, we develop equivalent continuum models which can reproduce the temperature, saturation, and pressure variation, and gas and liquid flow rates of the discrete fracture-porous matrix calculations. The equivalent continuum approach makes use of a generalized relative permeability concept to take into account for fracture effects. This results in a substantial simplification of the flow problem which makes larger scale modeling of complicated unsaturated fractured porous systems feasible. Potential applications for regional scale simulations and limitations of the continuum approach are discussed. 27 references, 13 figures, 2 tables.

10436 (NP—5770001, pp 1-26) **Photogrammetric survey of Qamanarssup sermia.** Tvis Knudsen, N.; Moeller, J.T. (Geologisk Institut, Aarhus Universitet). Oct 1982. NTIS (US Sales Only), PC A03/MF A01. File Number DE85770001.

In Glaciological investigations at Qamanarssup sermia.

Qamanarssup sermia is an outlet tongue from the Inland Ice in the inner part of Godthaabsfjord, Greenland. In 1978 the glacier covered an area of 748 km². In 1980 Qamanarssup sermia was surveyed by terrestrial photogrammetry. To establish a net of control points for this survey and a photogrammetric plot from aerial photographs taken in 1968, a triangulation was carried out around the periphery of the glacier. The maps will serve as a basis for mass balance and movement studies undertaken by Groenlands Geologiske Undersoegelser since 1979. In addition, important information on glacier variations can be gained. The field work carried out in the period 23rd July to 10th August, 1980 is described. Description is also given of the changes at the glacier margin during recent years together with general comments on information appearing in the maps.

10437 (NP—5770001, pp 27-42) **Surface velocity at Qamanarssup sermia 1980-81.** Andreasen, J.O. (Geologisk Institut, Aarhus Universitet). Oct 1982. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85770001.

In Glaciological investigations at Qamanarssup sermia. Field report 1980.

The results of measurements of surface motion at the glacier Qamanarssup sermia 1980-1981 are presented. Surface velocities were determined through theodolit measurements from stationary measuring stations. Annual, seasonal, and daily variatons are presented.

10438 **(NP—5770001) Glaciological investigations at Qamanarssup sermia.** (Groenlands Geologiske Undersoegelse, Copenhagen (Denmark)). Oct 1982. 44p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85770001.

Papers within the scope of EDB have been entered individually into the data base. (ACR)

10439 **(ORNL/TM—9354) Hydrologic investigations in the vicinity of the proposed Central Waste Disposal Facility, Oak Ridge National Laboratory, Tennessee.** Huff, D.D.; Frederick, B.J. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004949.

Data collection for hydrologic evaluation of the proposed Central Waste Disposal Facility (CWDF) site began in July 1982 with biweekly measurement of streamflows at seven locations. A recording rain gage was added in December 1982. The initial data suggested that annual runoff was highest at the basin outlet and that relative groundwater losses of 25 to 30% occurred at other subbasin measuring stations. Precipitation records indicate that normal annual precipitation at the CWDF site is approximately 1282 mm, which is 4% lower than that measured at the Oak Ridge townsite station. Continuous streamflow data have been collected at five sites in the CWDF drainage since November 1983. The expected average annual runoff at the site is 60 cm or an average flow rate of 48 L/s for the 2.44-km² basin. Measured values for 1983-84 show that flow is quite similar to that at nearby Walker Branch Watershed. Runoff is about 45% of precipitation. Tracer studies were used to examine subsurface flow pathways near planned disposal sites to points of emergence. Fluorescein dye was injected into a swallowhole that captures flow from one of the ephemeral streams draining the area. Dye was detected at both a shallow well and at a point of emergence of groundwater along the dry surface channel at a point downgrade of the swallow hole. Groundwater velocity in the subsurface system ranged from 620 to 1240 m/d for the upper part of the pathway, and from 240 to 380 m/d over the 1900-m route between injection and emergence. A greater than 10,000-fold reduction in peak concentration of dye was estimated. 11 references, 6 figures, 11 tables.

10440 **(USGS/WRIR—84-4133) Hydrogeologic reconnaissance of the San Miguel River basin, southwestern Colorado.** Ackerman, D.J.; Rush, F.E. (Geological Survey, Lakewood, CO (USA)). 1984. Contract AI97-79ET44611. 53p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85005203.

The San Miguel River basin is an area of 4130 square kilometers, of which about two-thirds is in the southeastern part of the Paradox basin. The Paradox basin is a part of the Colorado Plateaus that is underlain by a thick sequence of evaporite beds of Pennsylvanian age. The rock units that underlie the area have been grouped into hydrogeologic units based on their water-transmitting ability. Evaporite beds consisting mostly of salt are both overlain and underlain by confining beds. Aquifers are present above and below the confining-bed sequence. The principal element of ground-water outflow from the upper aquifer is flow to the San Miguel River and its tributaries; this averages about 90 million cubic meters per year. The aquifers generally are isolated from the evaporite beds by the bounding confining beds; as a result, most ground water has little, if any, contact with the evaporites. No natural brine flows have been identified in the basin. Salt water has been reported in petroleum-exploration wells, but no active salt solution has been located. 23 references, 8 figures, 4 tables.

5802 Geophysics

10441 **(SAND—84-2192C) Seafloor seismic measurements in the southern Bering.** Hickerson, J.P. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 8p. (CONF-8411108—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004908.

From Arctic energy technologies workshop; Morgantown, WV, USA (14 Nov 1984).

The paper discusses the plans being made to monitor the earthquake response of seafloor sediments in and near southwestern Alaskan offshore leasing areas. These sites possess high seismicity for which limited data exist. The Sandia Seafloor Earthquake Measurement System (SEMS) would be deployed to collect the necessary data over an eight-year time span. A proposal for a joint industry-government project to accomplish this goal has been circulated. 9 references, 4 figures, 1 table.

10442 **Detecting high-contrast seismic anomalies using cross-borehole probing.** Lytle, R.J.; Portroff, M.R. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Geoscience and Remote Sensing;* GE-22: No. 2, 93-98(Mar 1984).

Seismic probing between boreholes is useful for locating high-contrast geophysical anomalies such as an abandoned tunnel. Theoretical studies of continuous wave (CW) seismic wave interaction with a tunnel show that both the signal minima and the phase structure of the received signal can be used for locating the anomaly. The theoretical studies show that as the source and receiver are lowered in separate boreholes straddling the anomaly, the signal minima and the phase structure can be interpreted to yield both the lateral and vertical positions of the anomaly. Plane waves of compressional, horizontally polarized shear, and vertically polarized shear wave types incident on a cylindrical horizontal anomaly have been considered. The total seismic field has been calculated using an exact formulation. The variation of the response is studied as a function of the ratio of anomaly diameter to wavelength. The resulting fields in the receiver borehole are an effective diagnostic when a wavelength in the surrounding medium is less than or equal to the diameter of the anomaly. These results are analogous to the corresponding electromagnetic case which has been studied previously.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 5803009557, 9613

10443 **(ORNL/TM—9361) Mineralogical characterization of West Chestnut Ridge soils.** Lee, S.Y.; Kopp, O.C.; Lietzke, D.A. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 85p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85004768.

Environmental Sciences Division Publication No. 2418.

The morphological, physicochemical, and mineralogical properties of the soils and residua from the proposed site of the Central Waste Disposal Facility were characterized. The proposed site is underlain by cherty dolostones, limestones, and shales of the Knox Group covered by a thick residuum. Three diagnostic horizons from four soil profiles and six samples from residuum cores were selected for mineralogical analysis. The coarse fractions (gravel and sand) of the samples included different types of chert, iron-manganese oxide nodules, and quartz. The samples were high in clay content (except those from the A and E horizons) and low in pH and base saturation. The clay fractions were composed of varying amounts of kaolinite, mica, vermiculite, aluminum hydroxy-interlayered vermiculite, amorphous iron and aluminum oxides, gibbsite, and quartz. Aluminum hydroxy-interlayered vermiculite is the major component in surface horizons, but kaolinite becomes dominant in subsurface horizons of the soils. Degradation of kaolinite and formation of aluminum hydroxy-interlayered vermiculite and iron and aluminum oxides are pronounced chemical weathering processes in the surface soils. The aluminum hydroxy interlayering of vermiculite reduces cation exchange and selective sorption capacities of soils. In the residua, micaceous minerals free of aluminum hydroxy interlayering, kaolinite, and amorphous iron and aluminum oxides are major components in the clay fraction. The sorption ratios of ^{137}Cs, ^{90}Sr, ^{60}Co, and the uranium isotopes expected to be in the radioactive wastes should be very high for the clays having such mineralogical composition. The low acid-buffering capacity (base saturation) of the residua suggest that the fragile chemical and mineralogical equilibria can be easily broken if an extreme chemical condition is imposed on the residua.

10444 **(SAND—84-1060) Petrology and geochemistry of samples from bed-contact zones in Tunnel Bed 5, U12g-Tunnel, Nevada Test Site.** Connolly, J.R.; Keil, K.; Mansker, W.L.; Allen, C.C.; Husler, J.; Lowy, R.; Fortney, D.R.; Lappin, A.R. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1984. Contract AC04-76DP00789. 43p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004656.

This report summarizes the detailed geologic characterization of samples of bed-contact zones and surrounding nonwelded bedded tuffs, both within Tunnel Bed 5, that are exposed in the G-Tunnel complex beneath Rainier Mesa on the Nevada Test Site (NTS). Original planning studies treated the bed-contact zones in Tunnel Bed 5 as simple planar surfaces of relatively high permeability. Detailed characterization, however, indicates that these zones have a finite thickness, are depositional in origin, vary considerably over short vertical and horizontal distances, and are internally complex. Fluid flow in a sequence of nonwelded zeolitized ash-flow or bedded tuffs and thin intervening reworked zones appears to be a porous-medium phenomenon, regardless of the presence of layering. There are no consistent differences in either bulk composition or detailed mineralogy between bedded tuffs and bed-contact zones in Tunnel Bed 5. Although the original bulk composition of Tunnel Bed 5 was probably peralkaline, extensive zeolitization has resulted in a present peraluminous bulk composition of both bedded tuffs and bed-contact zones. The major zeolite present, clinoptilolite, is intermediate (Ca:K:Na = 26:35:39) and effectively uniform in composition. This composition is similar to that of clinoptilolite from the tuffaceous beds of Calico Hills above the static water level in hole USW G-1, but somewhat different from that reported for zeolites from below the static water level in USW G-2. Tunnel Bed 5 also contains abundant hydrous manganese oxides. The similarity in composition of the clinoptilolites from Tunnel Bed 5 and those above the static water level at Yucca Mountain indicates that many of the results of nuclide-migration experiments in Tunnel Bed 5 would be transferrable to zeolitized nonwelded tuffs above the static water level at Yucca Mountain.

10445 **(UCRL—53568) Numerical modeling of the mechanics of nonlinear porous media under dynamic loading.** Swift, R.P.; Burton, D.E. (Lawrence Livermore National Lab., CA (USA)). Jul 1984. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004631.

A multiphase continuum model that couples nonlinear deformation to porous flow has been developed and adapted for numerical analyses of dynamic and quasistatic behavior in the explicit finit-difference code TENSOR. In a physical sense the model describes a solid skeletal material containing flaws configured either as pores or stress-induced tensil cracks. These flaws may be filled with a multiphase fluid (e.g., air and water) whose transient behavior is governed by a dynamic flow model that reduces to classical Darcy flow for a single-phase fluid in the limit of quasistatic behavior. Dynamic mixture theory is used to account for coupling effects between phases. Nonlinear material behavior representing the drained response of the porous solid has been combined with the multiphase flow model to account for the effects of pore pressure on compaction, shear failure, and tensile failure. Numerical calculations are presented using both the multiphase model and a single-phase model to simulate the spherical response from explosive experiments performed on grout spheres. Good agreement with the measured particle velocity is obtained with both models. However, the phenomenology associated with explosively generated cavities using the multiphase model differs markedly from that obtained with a single-phase model. Notably, a region of liquefaction surrounding the cavity is created as a result of pore-pressure-induced tensile failure during shock wave passage. This precludes the development of a residual stress field adjacent to the cavity, as typically

calculated with a single-phase model. A small residual stress field is formed beyond the liquefied region. The formation of the residual stress field using the multiphase model and its stability during subsequent readjustment caused by pore-fluid migration is greatly enhanced with a small initial amount of air-filled porosity. 46 references, 15 figures.

5804 Geochemistry

REFER ALSO TO CITATION(S) 58040010444

5805 Oceanography

10446 **(DOE/EV/00936—1-Vol.1) Biological processes in the water column of the South Atlantic Bight. Volume 1. Published manuscripts. Progress report, June 1982-June 1985.** Paffenhofer, G.A.; Yoder, J.A. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 14 Dec 1984. Contract AS09-76EV00936. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004610.

Effects of the Gulf Stream on the outer southeastern US continental shelf were determined. The relationships of phytoplankton productivity and related processes to the oceanography of the inner shelf were investigated. Upwelling studies on the northeastern Florida shelf are described, and feeding and excretory rates of juvenile and adult zooplankton characteristic of advanced and matured upwellings on the southeastern continental shelf are reported. 6 figures. (ACR)

10447 **(DOE/EV/10331—T4) Nearshore transport processes affecting the dilution and fate of energy-related contaminants. Progress report, 1 June 1981-30 November 1984.** Blanton, J.O. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 17 Dec 1984. Contract AS09-80EV10331. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004004.

Several tasks have been conducted to address the physical exchange processes on the inner shelf. Two experiments were conducted with anchored ships to obtain a snapshot of the cross-front advection and diffusion of salt and momentum. These measurements will also support the determination of cross-front and along-front advection of salt and other material. Second, we have constructed a numerical model of a small section of the inner shelf which is driven by the M2 tide at the shelf break. The model has demonstrated the importance of tidal exchange between inlets and the inner shelf through the nonlinear interaction of tidal currents with complex bottom bathymetry. This mechanism conceivably transports material from sound to sound. The model has located shallow water areas where tidal currents are likely to create vertically homogeneous conditions within the frontal zone. Third, we have investigated available current meter data in regions shallower than 20 m where the frictional influence of surface and bottom stress are likely to merge. We have shown that a linear barotropic model that assumes along-shelf homogeneity can explain the observed phase relationships between the currents, coastal sea level and wind stress. The inner shelf is a dynamic system in which physical, chemical and biological characteristics vary in time and space. These characteristics influence various biological, chemical and physical processes that control the fate of materials in time and space. Some components of research are directed toward determining how characteristics of the inner shelf vary temporally and spatially.

64 PHYSICS, I.

6401 Astrophysics And Cosmology

10448 **(AD-A—144178/1) Numerical simulation study of solar wind disturbances responsible for geomagnetic and auroral storms. Final report 11 December 1980-11 November 1983.** Akasofu, S.I. (Alaska Univ., College (USA). Geophysical Inst.). 31 Jan 1984. 39p. NTIS, PC A03/MF A01.

During the last 12 months, we have made significant progress in three areas, (i) the simulation of propagation of flare-generated shock waves; (ii) dynamo processes associated with solar flares; and (iii) the simulation of sunspot formation. During the next 12 months, we plan to extend our studies in the same three areas. Some of the highlights and the future plans are described. Specifically, we have constructed a code to deal with the propagation of shock waves generated by six successive flares and plan to study several observed events on the basis of the code. We have developed a dynamo theory of the solar flares and plan to simulate time-dependent models by a MHD simulation method. We plan to examine observed velocity fields around sunspots in connection with our dynamo theory of solar flares. It is also our plan to extend our simulation study of sunspots by including magnetic buoyancy and other factors. Topics also include a solar wind study by the kinematic simulation method, and a study of the relationship between sunspot fields and transient IMF (Intermediate Magnetic Field) variations.

10449 **(AD-A—144990/9) Structure and evoluton of the large scale solar and heliospheric magnetic fields. Doctoral thesis.** Hoeksema, J.T. (Stanford Univ., CA (USA). Center for Space Science and Astrophysics). Apr 1984. 232p. NTIS, PC A11/MF A01.

Sponsored in part by Grants NGR-05-020-559 and NSF-ATM77-20580.

Structure and evolution of large scale photospheric and coronal magnetic fields in the interval 1976-1983 were studied using observations from the Stanford Solar Observatory and a potential field model. The solar wind in the heliosphere is organized into large regions in which the magnetic field has a componenet either toward or away from the sun. The model predicts the location of the current sheet separating these regions. Near solar minimum, in 1976, the current sheet lay within a few degrees of the solar equator having two extensions north and south of the equator. Soon after minimum the latitudinal extent began to increase. The sheet reached to at least 50 deg from 1978 through 1983. The complex structure near maximum occasionally included multiple current sheets. Large scale structures persist for up to two years during the entire interval. To minimize errors in determining the structure of the heliospheric field particular attention was paid to decreasing the distorting effects of rapid field evolution, finding the optimum source surface radius, determining the correction to the sun's polar field, and handling missing data. The predicted structure agrees with direct interplanetary field measurements taken near the ecliptic and with coronameter and interplanetary scintillation measurements which infer the three dimensional interplanetary magnetic structure. During most of the solar cycle the heliospheric field cannot be adequately described as a dipole.

10450 **(AD-A—145009/7) Studies of solar flares and coronal loops. Final scientific report 1 February 1982-31 May 1984.** Canfield, R.C. (California Univ., San Diego, La Jolla (USA). Center for Astrophysics and Space Sciences). 10 Jul 1984. 241p. (UCSD-SP—84-21). NTIS, PC A11/MF A01.

The objectives of this research were to improve our understanding of solar flares and solar coronal loops. The specific approach to the flare objective was to analyze and interpret solar flare data, using theoretical methods developed as part of the research. The specific approach to the coronal loop objective was to investigate their thermal and magnetohydrodynamic stability for various physical models. The principal result of the flare research was to demonstrate that, in two well-observed flares, the mechanism of chromospheric evaporation accounts for the observed amount of flare X-ray plasma. The dominant energy transport mechanism is thermal conduction. Heating by energetic electrons is of secondary importance. The principal results of the magnetohydrodynamic stability analyses were demonstrations of the role of radiative energy loss, compressibility, magnetic field line twist, footpoint magnetic field line tying, and radial plasma pressure gradient.

10451 **(AD-A—145130/1) Interplanetary cosmic ray intensity: 1972-1984 and out to 32 AU. Progress report.** Van Allen, J.A.; Randall, B.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Aug 1984. 63p. NTIS, PC A04/MF A01.

Using a number of Geiger-Mueller tubes in the University of Iowa instruments on Pioneer 10 and Pioneer 11, we have measured

the interplanetary intensity of cosmic rays E sub P > 80 meV) over a complete solar activity cycle and out to a helicocentric distance of over 32 AU. Free space values of the background corrections due to the radioisotope thermal generators were determined during passage of Pioneer 11 under the dense rings of Saturn during the 1 September 1979 encounter. These improved corrections and ones inferred therefrom for Pioneer 10 have supplanted earlier estimates and have been applied to all data.

10452 **(BNL—35705) Cosmic-ray depth studies at the Homestake Mine with $^{39}K \rightarrow {}^{37}Ar$ detectors.** Fireman, E.L.; Cleveland, B.T.; Davis, R. Jr.; Rowley, J.K. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA); Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 10p. (CONF-8408132—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004710.

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

The argon-37 production rates in potassium detectors are measured at depths down to 4850 ft (4000 m.w.e.), the location of the chlorine solar neutrino detector in the Homestake Mine. The depth variation of the ^{37}Ar production rates in K agrees with that expected from cosmic ray muon interactions. At shallow depths, the ^{37}Ar production rates in K parallel those in Cl, with the ^{37}Ar rate per ton K equal to the ^{37}Ar rate per 615 tons of C_2Cl_4. At 4850 ft depth, the measurements give 0.07 +- 0.07 $^{37}Ar\ day^{-1}$ per ton of K, which is to be compared to the value of 0.46 +- 0.04 $^{37}Ar\ day^{-1}$ per 615 tons of C_2Cl_4 in the solar neutrino detector. The comparison indicates that there is an excess of ^{37}Ar over the cosmic-ray production in chlorine at 4850 ft depth; however, the error in the K measurements at 4850 ft depth is presently too large to determine accurately the cosmic ray background of the solar neutrino experiment. This error will be reduced by additional measurements. 11 references, 3 tables.

10453 (BNL—51778, pp 485-502) **Applications for fission product data to problems in stellar nucleosynthesis.** Mathews, G.J. (Lawrence Livermore National Lab., CA). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—). Contract W-7405-ENG-48.

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

A general overview of the nucleosynthesis mechanisms for heavy (A ~ > 70) nuclei is presented with particular emphasis on critical data needs. The current state of the art in nucleosynthesis models is described and areas in which fission product data may provide useful insight are proposed.

10454 **(LA-UR—84-3583) Constraints of observations of solar oscillations on solar models with mixing by turbulent diffusion.** Cox, A.N.; Kidman, R.B.; Newman, M.J. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 14p. (CONF-8408132—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003741.

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

The pulsational behavior of solar models with mixing produced by turbulent diffusion has been investigated, for both p (pressure) modes and g (gravity) modes. It is found that while a small amount of mixing may be allowed by the observed data on solar oscillations, values of the pseudo-Reynolds number large enough to reduce the predicted neutrino counting rate to the level seen by the ^{37}Cl experiment are in conflict with published solar oscillation data. 8 references, 8 figures, 2 tables.

10455 **(LA-UR—84-3688) Comet showers and Nemesis, the death star.** Hills, J.G. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 9p. (CONF-8405262—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003736.

From Southwest regional conference for astronomy and astrophysics; Los Alamos, NM, USA (1 May 1984).

The recently proposed hypothesis that the periodic extinctions of terrestrial species are the result of comet showers catalyzed by a hypothetical distant solar companion, Nemesis, a tale of global death by comet bombardment of the earth, is discussed. (GHT)

10456 **(N—84-24660) Interstellar-gas experiment (A0038).** Lind, D.L.; Geiss, J. (National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). Feb 1984. 3p. NTIS, PC A09/MF A01.

In NASA. Langley Research Center, long duration exposure facility (LDEF), 98-100, N—84-24632 15-15.

The objectives of this experiment are to collect and isotopically analyze interstellar gas atoms around the orbit of the Earth for the purpose of obtaining new data relevant to understanding nucleosynthesis, and to study the dynamics of the interstellar wind inside the heliosphere and the isotopic composition of the interstellar medium outside the heliosphere. The experiment hardware will act as a set of simple cameras with high-purity copper-beryllium collecting foils serving as the film. The experiment housing will mount and thermally control the foils, establish the viewing angles and viewing direction, provide baffling to reject ambient neutral particles, provide a voltage grid to reject ionospheric charged particles, sequence collecting foils, control exposure times, and protect the foils from contamination during the deployment and retrieval of the LDEF. After being returned to Earth, the entrapped atoms can be analyzed by mass spectroscopy to determine the relative abundance of the different isotopes of helium and neon. An attempt will also be made to detect argon.

10457 **(N—84-25557) Activities report of the Institute of Extraterrestrial Physics.** (Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik). Jan 1984. 118p. (In German). (MPE—181). NTIS, PC A06/MF A01.

Activities in the area of extraterrestrial physics are reported. The experiments are conducted in the upper Earth atmosphere. Investigations are conducted by balloons, rockets, satellites and space probes. Investigations are performed in three different methods: (1) in situ outerspace measurements and (3) laboratory measurements.

10458 **(N—84-25560) Ultraviolet and X-ray observations of active galactic nuclei: constraints on models of the broad emission line region.** Mushotzky, R.F. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Apr 1984. 9p. NTIS, PC A02/MF A01.

In LHEA contribution to the future ultraviolet astronomy based on six years of IUE research, 1-9, N—84-25559 15-89.

Many active galactic nuclei, in particular quasars and Seyfert I's, are characterized by strong, broad emission lines from permitted transitions in abundant elements. In the simplest models, these lines originate in clouds located at some characteristic distance from the central ionizing source in a quasi-spherical distribution. Ultraviolet and X-ray spectroscopic data gathered from the International Ultraviolet Explorer (IUE), HEAO 1, and HEAO 2 are utilized herein to further define and refine the photoionization models of the broad emission line region (BLR) of these galactic nuclei. Parameters including X-ray spectra, X-ray absorption, ultraviolet spectra, hydrogen cloud geometry, cosmic dust, cloud metallicity, and continuous spectra are considered. The luminosity of galactic nuclei is also discussed.

10459 **(N—84-25561) Very recent IUE observations of 2 BL Lacertae orbits.** Urry, C.M.; Kondo, Y.; Hackney, K.R.H. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Apr 1984. 4p. NTIS, PC A02/MF A01.

In LHEA contribution to the future ultraviolet astronomy based on six years of IUE research, 10-13, N—84-25559 15-89.

Spectroscopic observations of two BL Lacertae objects consisting of 2 spectra of 1218+304 and 12 spectra of MrK 421 are presented. Data were generated by the International Ultraviolet Explorer (IUE) and HEAO 1. The former BL object was never before observed with IUE, possibly because it is very faint, but the fact that it is an X-ray source, and a highly variable one, makes it particularly interesting. MrK 421 was observed many times before with IUE as part of a continuing monitoring program. The present observations indicate an intensity decrease of approximately 25% on a timescale of one month, with little or no associated spectral change. With one exception, the spectra of these two BL objects show no discrete features, and the continua are well fit by the

power law models. The one exception is a long exposure of MrK 421 which showed a broad emission feature near 1580 A. The validity of this feature is not yet established.

10460 **(N—84-25565) Matter antimatter domains: a possible solution to the CP domain wall problem in the early universe.** Mohanty, A.K.; Stecker, F.W. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). May 1984. 19p. (NASA-TM—86100). NTIS, PC A02/MF A01.

An SU(5) grand unified theory model is used to show how the degeneracy between vacua with different spontaneously broken charge parity can be dynamically lifted by a condensate of heavy fermion pairs. This drives a phase transition to a unique vacuum state with definite charge parity. The transition eliminates the domain walls in a matter antimatter symmetric domain cosmology.

10461 **(N—84-25891) Submilliarcsecond VLBI observations of the close pair GC 1342+662 and GC 1342+663.** Morabito, D.D. (Jet Propulsion Lab., Pasadena, CA (USA)). Mar 1984. 7p. NTIS, PC A08/MF A01.

In Telecommunications and data acquisition report, 12-18, N—84-25889 16-32.

Differential VLBI was simultaneously performed on the source pair GC 1342+662 and GC 1342+663 (4.4-arcminute separation) using S-band on the Goldstone/Madrid baseline. These measurements were acquired on two separate observing sessions: 30 December 1982 and 14 May 1983. The change in separation of GC 1342+662 relative to GC 1342+663 between the two epochs was 0.03 + or 0.08 milliarcsecond. The differences of the relative position measurements between epochs of GC 1342+662 relative to GC 1342+663 were -0.29 + or - 0.05 milliarcsecond in right ascension and 0.14 + or - 0.09 milliarcsecond in declination. These measurements demonstrate submilliarcsecond accuracy and repeatability. The discrepancies outside of the formal uncertainties could be attributed to the intrinsic properties of the sources such as structure and to a lesser probability, proper motion. These discrepancies could also be attributed to excursions in UT1-UTC of about four times the quoted BIH uncertainty.

10462 **(N—84-26488) Supernovae as a source of interstellar dust: the current observational picture.** Dinerstein, H.L. (Texas Univ., Austin (USA)). 1984. 3p. NTIS, PC A09/MF A01.

In Royal Observatory, proceedings of the workshop on laboratory and observational infrared spectra of interstellar dust, 33-35, N—84-26485 16-88.

Supernovae have been generally thought of as being effective agents for the destruction of ambient interstellar dust. The idea that supernovae may also be a source of dust has been of interest recently, and is attractive for a couple of reasons. The main motivation is to explain meteoritic inclusions with peculiar isotopic abundance ratios as supernova dust condensates predating the solar nebula. In addition, although the nucleation process is not fully understood, the high concentration of condensable elements in the supernova mantle suggests the possibility that grain formation could be very efficient. In this case, supernovae could be a major source of new grain cores to the interstellar medium. In the last few years, several galactic novae have been observed to develop thermal infrared components with temperatures of about 1000 K, on the order of 50 days after the initial flare-up. The development of this infrared component has been interpreted as indicating the condensation of new grains. Evidence for dust formation soon after nova outbursts is interesting because of similarities between conditions in the nova shell to those in supernova ejecta. The current observational evidence with respect to dust formation in supernovae is summarized.

10463 **(N—84-26500) Origins of the 3.28 micron dust emission feature.** Gatley, I. (United Kingdom Infrared Telescope Unit, Hilo, HI). 1984. 10p. NTIS, PC A09/MF A01.

In Royal Observatory, proceedings of the workshop on laboratory and observational infrared spectra of interstellar dust, 118-127, N—84-26485 16-88.

Some practical problems encountered in making spectroscopic observations in the 3 to 4 micron wavelength range are discussed. Emphasis is placed on the interpretation of observations of the galactic center, and their implications for the origins of the 3.28 micron dust emission feature. These observations suggest, in contrast to some previous analyses, that the carrier of the 3.28 micron feature may be a common, non-volatile component of interstellar grains.

10464 **(N—84-26501) Quenched Carbonaceous Composite (QCC): a likely candidate for interstellar grains.** Sakata, A.; Wada, S. (University of Electro-Communications, Chofu, Tokyo (Japan)). 1984. 9p. NTIS, PC A09/MF A01.

In Royal Observatory, proceedings of the workshop on laboratory and observational infrared spectra of interstellar dust, 128-136, N—84-26485 16-88.

A carbonaceous composite synthesized from hydrocarbon plasma shows an extinction property resembling the observed average interstellar extinction curve around the 220 nm hump. This composite is synthesized by quenching the excited gas ejecting from a plasma of methane gas, thus it is termed quenched carbonaceous composite or QCC. Quenched carbonaceous composite was investigated in the infrared region. It was found that QCC can account for some of the unidentified bands in the infrared region detected in several celestial objects. These features can be interpreted in terms of vibrational modes of adsorbed molecules, radicals and atoms, or surface functional groups of atoms which themselves constitute QCC. These results suggest that most of the pronounced features of the interstellar grains, such as the 220 nm hump and the infrared unidentified bands, originate from substances whose major constituent is carbon. The infrared spectrum of QCC are presented and interpretations of the features are given. A picture of QCC inferred from these data is also discussed.

10465 **(N—84-26504) Nova Aquilae 1982: the nature of its dust.** Longmore, A.J.; Williams, P.M. (Kyoto Univ. (Japan)). 1984. 5p. NTIS, PC A09/MF A01.

In Royal Observatory, proceedings of the workshop on laboratory and observational infrared spectra of interstellar dust, 153-157, N—84-26485 16-88.

Novae were long recognized as providing one of many mechanisms for the return of material from stars to the interstellar medium. It is unlikely that the nova stage itself plays a dominant role amongst these mechanisms, but it is still a force to be reckoned with. It is not surprising that along with the (typically) approximately 0.1 solar mass of gas released in the nova event, a much smaller mass of dust grains might be found. Infrared photometric measurements of novae have indeed found dust to be present. However, 1 to 20 micron observations of Nova Aquilae 1982 show that the conventional picture of dust forming in the nova ejecta does not apply in this case, and suggest a re-examination of the infrared modelling of earlier novae would be worthwhile.

10466 **(N—84-26505) Infrared polarimetry of young clusters.** Dinerstein, H.L. (Texas Univ., Austin (USA)). 1984. 4p. NTIS, PC A09/MF A01.

In Royal Observatory, proceedings of the workshop on laboratory and observational infrared spectra of interstellar dust, 158-161, N—84-26485 16-88.

Infrared polarimetry is a rapidly developing new technique with great promise for studying young stellar clusters and the dust in their vicinities. The high linear polarization of the BN source in the near-infrared was discovered about 15 years ago, and explained as selective extinction by cold grains aligned by a magnetic field. This is an extension to much larger column densities of the dichromic absorption mechanism responsible for the polarization of optical stellar light passing through the diffuse interstellar medium. Since then, many other point sources in molecular clouds were found to have relatively high polarizations in the near infrared. Some of the current directions in which infrared polarization studies are progressing include higher spatial resolution, more complete wavelength coverage, and higher spectral resolution work.

10467 **(N—84-26535) Self-regulating galaxy formation. Part 1: HII disk and Lyman alpha pressure.** Cox, D.P. (Rice Univ., Houston, TX (USA)). 1983. 79p. (NASA-CR—173592). NTIS, PC A05/MF A01.

Assuming a simple but physically based prototype for behavior of interstellar material during formation of a disk galaxy, coupled with the lowest order description of infall, a scenario is developed for self-regulated disk galaxy formation. Radiation pressure, particularly that of Lyman alpha (from fluorescence conversion Lyman continuum), is an essential component, maintaining an inflated disk and stopping infall when only a small fraction of the overall perturbation has joined the disk. The resulting galaxies consist of a two dimensional family whose typical scales and surface density are expressable in terms of fundamental constants. The model leads naturally to galaxies with a rich circumgalactic environment and flat rotation curves (but is weak in its analysis of the subsequent evolution of halo material).

10468 **(N—84-26536) Research in extragalactic astrophysics. Final Report.** Bahcall, N. (Princeton Univ., NJ (USA)). Jun 1984. 3p. (NASA-CR—173608). NTIS, PC A02/MF A01.

The spatial distribution of clusters of galaxies and the large scale structure of the universe is investigated. Correlations in the spatial cluster distribution are much stronger than those seen for galaxies, and over scales much larger than previously anticipated. The following main studies are completed and published (1) The determination of the correlation functions of rich clusters of galaxies, and its dependence on richness and other parameters. Very large scale structure exists in the universe, and rich clusters participate in this structure more efficiently than galaxies. (2) A complete catalog of superclusters, is determined. The selection criteria is that of a volume density enhancement, and is done in 3 dimensions. (3) The giant galaxy void in Bootes is found to be surrouned by rich, large superclusters from the catalog described above. (4) A very large scale void of rich clusters of galaxies is found in the study of the spatial distribution of rich clusters.

10469 **(N—84-26537) V-V compact group of galaxies. Final Report.** Bahcall, N. (Princeton Univ., NJ (USA)). Jun 1984. 16p. (NASA-CR—173609). NTIS, PC A02/MF A01.

A search for X-ray emission from five compact groups of galaxies with the Einstein Observatory revealed detections from three groups. Soft, extended X-ray emission was observed in Stephan's Quintet which is most likely caused by hot intracluster gas. This provides evidence for dynamical interaction among the group galaxies. X-ray emission from the group Arp 330 may also originate in hot intracluster gas. Stephan's Quintet and Arp 330 have the largest velocity dispersions among the groups studied suggesting a correlation between high velocity and the release (or properties) of hot gas. X-ray emission from Arp 318 may originate in its member galaxies.

10470 **(N—84-32333) Large amplitude MHD waves upstream of the Jovian bow shock: reinterpretation.** Goldstein, M.L.; Wong, H.K.; Vinas, A.F.; Smith, C.W. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1984. 34p. (NASA-TM—86131). NTIS, PC A03/MF A01.

Observations of large amplitude magnetohydrodynamic (MHD) waves upstream of the Jovian bow shock were previously interpreted as arising from a resonant electromagnetic ion beam instability. That interpretation was based on the conclusion that the observed fluctuations were predominantly right elliptically polarized in the solar wind rest frame. Because it was noted that the fluctuations are, in fact, left elliptically polarized, a reanalysis of the observations was necessary. Several mechanisms for producing left hand polarized MHD waves in the observed frequency range were investigated. Instabilities excited by protons appear unlikely to account for the observations. A resonant instability excited by relativistic electrons escaping from the Jovian magnetosphere is a likely source of free energy consistent with the observations. Evidence for the existence of such a population of electrons was found in both the Low Energy Charged Particle experiments and Cosmic Ray experiments on Voyager 2.

10471 **(N—84-32337) Two probable optical flashes from gamma-ray bursters.** Schaefer, B.E.; Bradt, H.V.; Barat, C.; Hurley, K.; Niel, M.; Vedrenne, G.; Cline, T.L.; Desai, U.; Teegarden, B.G.; Evans, W.D. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1984. 15p. (NASA-TM—86126). NTIS, PC A02/MF A01.

Two images on archival photographic plates which are most likely records of optical flashes from gamma-ray bursters (GRBs) were examined. One of these images appears on a 1901 plate in the field of the 5 Nov. 1979 GRB, while the other is in the field of the 13 Jan. 1979 GRB on a plate exposed in 1944. The 1901 optical transient image is circular in shape, while all normal star images are trailed by 8 in. No optical transients are found in a control region which is 34.3 times larger than the GRB error regions examined. Independent limits on the optical flash rate from the sky yield a probability of less than 0.0001 that any one of the optical transients is due to a background flash. A total exposure of 2.7 years was examined for GRB flashes at known GRB locations on the Harvard plates and a total of three GRB flashes were seen, that the average recurrence time scale for optical flashes is roughly one year. The optical fluence of these optical flashes was measured. For the three currently known GRB optical flashes, the ratio of gamma-ray fluence (from a modern burst) to the optical fluence (from a archival burst) were measured to be 800, 900, and 900.

10472 **(N—84-32338) Photon-photon absorption and the uniqueness of the spectra of active galactic nuclei.** Kazanas, D. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). May 1984. 16p. (NASA-TM—86117). NTIS, PC A02/MF A01.

The effects of the feedback of e(+)-e(-) pair reinjection in a plasma due to photon-photon absorption of its own radiation was examined. Under the assumption of continuous electron injection with a power law spectrum E to the minus gamma power and Compton losses only, it is shown that for gamma 2 the steady state electron distribution function has a unique form independent of the primary injection spectrum. This electron distribution function can, by synchrotron emission, reproduce the general characteristics of the observed radio to optical active galactic nuclei spectra. Inverse Compton scattering of the synchrotron photons by the same electron distribution can account for their X-ray spectra, and also implies gamma ray emission from these objects. This result is invoked to account for the similarity of these spectra, and it is consistent with observations of the diffuse gamma ray background.

10473 **(N—84-33310) Observations of the ultraviolet spectra of helium (DB) white dwarfs and a study of the ultraviolet spectra of white dwarfs containing carbon.** Wegner, G.A. (Dartmouth Coll., Hanover, NH (USA)). Sep 1984. 13p. (NASA-CR—173889). NTIS, PC A02/MF A01.

Strong ultraviolet carbon lines were detected in the spectrum of the southern DC white dwarf BPM 11668. Observations of a number of hotter DB white dwarfs with IUE show no evidence of carbon features. Two additional DA white dwarfs were observed that have the strong unidentified absorption near 1400 A which now seems to be identified with another lower temperature feature as satellite lines to Lyman alpha radiation.

10474 **(N—84-33315) Research relative to high energy astrophysics. Final Report, 1 February 1983-31 May 1984.** Gorenstein, P. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). Aug 1984. 55p. (NASA-CR—173878). NTIS, PC A04/MF A01.

Various parameters which affect the design of the proposed large area modular array of reflectors (LAMAR) are considered, including thermal control, high resolution X-ray spectroscopy, pointing control, and mirror performance. The LAMAR instrument is to be a shuttle-launched X-ray observatory to carry out cosmic X-ray investigations. The capabilities of LAMAR are enumerated. Angular resolution performance of the mirror module prototype was measured to be 30 sec of ARC for 50% of the power. The LAMAR thermal pre-collimator design concepts and test configurations are discussed in detail.

10475 **(N—84-33317) Axions, neutrinos and strings: the formation of structure in an SO(10) universe.** Stecker, F.W. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1984. 10p. (NASA-TM—86139). NTIS, PC A02/MF A01.

In a class of grand unified theories containing SO(10), cosmologically significant axion and neutrino energy densities are obtainable naturally. To obtain large scale structure, both components of dark matter are considered to exist with comparable energy densities. To obtain large scale structure, inflationary and non-inflationary scenarios are considered, as well as scenarios with and without vacuum strings. It is shown that inflation may be compatible with recent observations of the mass density within galaxy clusters and superclusters, especially if strings are present.

10476 **(N—84-33319) Morphologic studies of the Moon and planets.** El-Baz, F.; Maxwell, T.A. (Itek Corp., Lexington, MA (USA). Optical Systems Div.). Sep 1984. 18p. (NASA-CR—173886). NTIS, PC A02/MF A01.

The impact, volcanic, and tectonic history of the Moon and planets were investigated over an eight year period. Research on the following topics is discussed: lunar craters, lunar basins, lunar volcanoes, correlation of Apollo geochemical data, lunar geology, Mars desert landforms, and Mars impact basins.

10477 **(N—84-33320) Geographic comparison of selected large-scale planetary surface features.** Meszaros, S.P. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1984. 65p. (NASA-TM—86147). NTIS, PC A04/MF A01.

Photographic and cartographic comparisons of geographic features on Mercury, the Moon, Earth, Mars, Ganymede, Callisto, Mimas, and Tethys are presented. Planetary structures caused by impacts, volcanism, tectonics, and other natural forces are included. Each feature is discussed individually and then those of similar origin are compared at the same scale.

10478 **(N—84-33322) Ionization structure of planetary nebulae V NGC 3242.** Barker, T. (Wheaton Coll., Norton, MA (USA)). 1984. 27p. (NASA-CR—173914). NTIS, PC A03/MF A01.

Spectrophotometric observations of emission line intensities over the spectral range 1400 A to 9600 A were made in five positions in the planetary nebula NGC 3242. In two of the positions, both the weakness of the 1548 A, 1550 A C IV resonance lines and the steepness of the Balmer decrement suggest the possibility of internal dust in the nebula. The measured electron temperature varies little from the average value of 11,100 K, which is in reasonably good agreement with the less accurate value of 12,900 K measured from the Balmer continuum. The 4267 A C II line implies a C(2+) abundance that is much higher than that determined from the 1906 A, 1908 A C III lines. This discrepancy decreases with increasing distance from the central star. Equations used to correct for the existence of elements in other than the optically-observable ionization stages give results that are consistent and in agreement with abundances calculated using ultraviolet lines. This discrepancy decreases with increasing distance from the central star. Equations used to correct for the existence of elements in other than the optically-observable ionization stages give results that are consistent and in agreement with abundances calculated using ultraviolet lines. The logarithmic abundances are He 10.96, 0 8.64, N 7.96, Ne 8.04, C 8.41, Ar 6.15, and S 6.51.

10479 **(N—84-33323) Trapped particle absorption by the Ring of Jupiter. Final Report, 15 April 1981-15 April 1983.** Fillius, W. (California Univ., San Diego, La Jolla (USA)). Apr 1983. 36p. (NASA-CR—173919). NTIS, PC A03/MF A01.

The interaction of trapped radiation with the ring of Jupiter is investigated. Because it is an identical problem, the rings of Saturn and Uranus are also examined. Data from the Pioneer II encounter, deductions for some of the properties of the rings of Jupiter and Saturn. Over a dozen Jupiter magnetic field models are available in a program that integrates the adiabatic invariants to compute B and L. This program is to label our UCSD Pioneer II encounter data with the most satisfactory of these models. The expected effects of absorbing material on the trapped radiation are studied to obtain the loss rate as a function of ring properties. Analysis of the particle diffusion problem rounds out the theoretical end of the ring absorption problem. Other projects include identification of decay products for energetic particle albedo off the rings and moons of Saturn and a search for flux transfer events at the Jovian magnetopause.

10480 **(N—84-33325) Expressions to determine temperatures and emission measures for solar X-ray events from GOES measurements.** Thomas, R.J.; Starr, R. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1984. 14p. (NASA-TM—86142). NTIS, PC A02/MF A01.

Expressions which give the effective color temperatures and corresponding emission measures for solar X-ray events observed with instruments onboard any of the GOES satellites are developed. Theoretical spectra were used to simulate the solar X-ray input at a variety of plasma temperatures. These spectra were folded through the wavelength dependent transfer functions for the two GOES detectors. The resulting detector responses and their ratio as a function of plasma temperature were then fit with simple analytic curves. Over the entire range between 5 and 30 million degrees, these fits reproduce the calculated color temperatures within 2% and the calculated emission measures within 5%. With the theoretical spectra, similar expressions for any pair of broadband X-ray detectors whose sensitivities are limited to wavelengths between 0.2 and 100 A are calculable.

10481 **(N—84-33326) Microwave and X-ray observations of delayed brightenings at sites remote from the primary flare locations.** Nakajima, H.; Dennis, B.R.; Hoyng, P.; Nelson, G.; Kosugi, T.; Kai, K. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1984. 47p. (NASA-TM—86140). NTIS, PC A03/MF A01.

Five examples of solar flares observed with the 17-GHz interferometer at Nobeyama in which a secondary microwave burst occurred at a distance of 100,000 km to 1,000,000 km from the primary flare site are presented. The secondary microwave burst in all five cases had a similar time profile to the primary burst with a delay of 2 to 25 s. The velocity of a triggering agent inferred from this delay and spatial separation is 10,000 km to 100,000 km/s. The intensity of the secondary burst was a factor of 3 to 25 smaller than that of the primary burst in all events except for one case in which it was a factor of 2 larger. The polarization degree of the secondary burst at 17 GHz was 35%, significantly higher than the average value for typical impulsive bursts. Two of the events were accompanied by meterwave type III/V bursts located high in the corona between the primary and secondary sites. For two of the other events, X-ray images of he secondary source were obtained with the hard-X-ray imaging spectrometer on the Solar Maximum Mission. These observations strongly suggest that the distant microwave bursts were produced by electrons with energies of 10 keV to 100 keV which were channeled along a huge loop from the main flare site to the remote location.

10482 **(N—84-33329) Solar-Geophysical Data, No. 475, March 1984. Part 1: Prompt reports. Data for September 1983, May 1981.** (National Geophysical Data Center, Boulder, CO (USA)). Mar 1984. 124p. (PB—84-201508; SGD—475-PT-1). NTIS, PC A06/MF A01.

A detailed index of observations published in Solar-Geophysical Data is presented. In addition, the following parameters are considered: solar activity, solar flares, solar radio emisson, inferred interplanetary magnetic field polarity, mean solar magnetic field, geomagnetic substorms, sudden ionospheric disturbances, cosmic ray measurements, sunspots, and radio propagation. Data are given in tabular form, and solar maps are included.

10483 **(N—84-33330) Solar-Geophysical Data, No. 475, March 1984. Part 2: comprehensive reports. Data for September 1983, May 1981 and miscellanea.** (National Geophysical Data Center, Boulder, CO (USA)). Mar 1984. 128p. (PB—84-201516; SGD—475-PT-2). NTIS, PC A07/MF A01.

A detailed index of observations published in Solar-Geophysical Data is presented. In addition, the following parameters are considered: Solar radio bursts, solar mass ejections, H-alpha solr flares, sunspots, and interplanetary solar particles. Data are given in tabular form, and synoptic solar maps are included.

10484 **(N—84-33332) Three precise gamma-ray burst source locations.** Cline, T.L.; Desai, U.D.; Teegarden, B.J.; Barat, C.; Hurley, K.; Niel, M.; Vedrenne, G. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1984. 16p. (NASA-TM—86132). NTIS, PC A02/MF A01.

The precise source regions of three moderately intense gamma ray bursts are derived. These events were observed with the first interplanetary burst sensor network. The optimum locations of the detectors, widely separated throughout the inner solar system, allowed for high accuracy, over-determined source fields of size 0.7 to 7.0 arc-min(2). All three locations are at fairly high galactic latitude in regions of low source confusion; none can be identified with a steady source object. Archived photographs were searched for optical transients that are able to be associated with these source fields; one such association was made.

10485 **(N—84-33333) Broad-band X-ray spectrum of a QSO sample.** Worrall, D.M.; Marshall, F.E. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1983. 25p. (NASA-TM—85071). NTIS, PC A02/MF A01.

A sample of 25 QSOs was used to investigate the average spectrum between the soft X-ray energy band of the Einstein Observatory image proportional counter, and the higher energy band of the HEAO 1 A2 experiment. The spectrum is similar to those exhibited by Seyfert galaxies and narrow emission line galaxies above 2 keV. The spectrum is soft enough that if these objects are typical of the higher red shift, more radio-quiet QSOs, then it is possible to exclude QSOs as being the dominant origin of the diffuse X-ray background.

10486 **(N—84-33349) Radio astronomy.** Barrett, A.H.; Burke, B.F.; Dreher, J.W.; Kyhl, R.L.; Lang, J.H.; Staelin, D.H.; Roberts, D.H.; Rosenkranz, P.W.; Shao, M.; Barrett, J.W. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1984. 9p. NTIS, PC A12/MF A01.

In RLE program report No. 126, 65-73, N—84-33336 22-99.

In radio astronomy programs of research on the interstellar medium and and star formation were pursued. Achievements are also summarized for studies of: (1) The distribution of matter in galaxies and clusters of galaxies; (2) software to analyze Jovian decametric data; (3) the two-color technique for obtaining relative astrometric positions with an interferometer; (4) continued improvement in the utilization of microwave data produced by NOAA satellites; (5) improved techniques for retrieval of atmospheric parameters from rassile microwave measurements o the Earth; (6) methods for obtaining high-spatial-resolution passive microwave sounding data; (7) meteorological measurement with the SMMR; (8) video-bandwith compression techniques and (9) the use of resolution-preserving interpolation techniques to reconstruct missing frames in a frame sequence.

10487 **(UCRL—90511) Processes and problems in secondary star formation.** Klein, R.I.; Whitaker, R.W.; Sandford M.T. II. (Lawrence Livermore National Lab., CA (USA); Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-48. 55p. (CONF-840183—1). NTIS, PC A04/MF A01; GPO Dep. File Number DE85003623.

From 2. protostars and planets conference; Tucson, AZ, USA (4 Jan 1984).

Recent developments relating the conditions in molecular clouds to star formation triggered by a prior stellar generation are reviewed. Primary processes are those that lead to the formation of a first stellar generation. The secondary processes that produce stars in response to effects caused by existing stars are compared and evaluated in terms of the observational data presently available. We discuss the role of turbulence to produce clumpy cloud structures and introduce new work on colliding inter-cloud gas flows leading to non-linear inhomogeneous cloud structures in an intially smooth cloud. This clumpy morphology has important consequences for secondary formation. The triggering processes of supernovae, stellar winds, and H II regions are discussed with emphasis on the consequences for radiation driven implosion as a promising secondary star formation mechanism. Detailed two-dimensional, radiation-hydrodynamic calculations of radiation driven implosion are discussed. This mechanism is shown to be highly efficient in synchronizing the formation of new stars in congruent to 1-3 x 10^4 years and could account for the recent evidence for new massive star formation in several UCHII regions. It is concluded that, while no single theory adequately explains the variety of star formation observed, a uniform description of star formation is likely to involve several secondary processes. Advances in the theory of star formation will require multiple dimensional calculations of coupled processes. The important non-linear interactions include hydrodynamics, radiation transport, and magnetic fields.

10488 **Detecting stellar collapse with neutrinos.** Burrows, A. (Department of Physics and Department of Earth and Space Sciences, SUNY at Stony Brook). *Astrophysical Journal;* **283**: No. 2, 848-852(15 Aug 1984). Contract AC02-80ER10719.

We estimate the distances out to which various terrestrial neutrino detectors can see a stellar collapse. With these ranges, we obtain neutrino burst detection rates. The mean time between detections is expected to be rather long. A realistic estimate for this time is ~50-100 years. Whether this is indeed the case depends sensitively on the as yet unknown mean energy of the emitted neutrinos and the galactic collapse rate.

10489 **Ultra high energy radiation from a black hole.** Oliensis, J.; Hill, C.T. (Argonne National Lab., IL). *Physics Letters, [Section] B;* **143**: No. 1-3, 92-96(9 Aug 1984).

We give a model independent estimate of the flux of high energy Hawking radiation from a black hole, E >> 100 GeV. We calculate the black hole contribution to ultra high energy cosmic rays and find that it is insignificant. We point out that the high energy radiation emitted by a real black hole is expected to be non-thermal.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 64020010448, 10457

10490 **(N—84-29374) Plasma and magnetospheric research.** Comfort, R.H.; Horwitz, J.L. (Alabama Univ., Huntsville (USA)). Jun 1984. 12p. (NASA-CR—171080). NTIS, PC A02/MF A01.

Research activities on the following topics were summarized: (1) software for the Space Plasma computer Analysis Network (SPAN), (2) plasmaspheric field-aligned temperature gradients, (3) the shift in spacecraft potential as a function of plasma density, (4) plasma flow, (5) the Fabry-Perot interferometer, and (6) the Differential Ion Flux Probe (DIFP).

10491 **(N—84-32336) Solar flares and magnetospheric particles: investigations based upon the ONR-602 experiment.** Wefel, J.P. (Louisiana State Univ., Baton Rouge (USA)). Jul 1984. 17p. (AD-A—143144). NTIS, PC A02/MF A01.

Investigations of the South Atlantic Anomaly region, the global distribution of low energy magnetospheric particles, and of the time dependence of the low energy particle fluxes have been initiated. Further, an initial analysis of the mass and charge composition of the solar energetic particles observed, over the polar regions, during the mission was completed. The remainder of this report will summarize the following topics: (1) Data processing/analysis, (2) Solar Energetic Particle composition (3) Global surveys of low energy particle radiation, and (4) The South Atlantic Anomaly region.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 64030010122, 10163, 10269, 10560

10492 **(BNL—35594) Resonant-transfer-and-excitation for highly charged ions (16 ≦ Z ≦ 23) in collisions with helium.** Tanis, J.A.; Bernstein, E.M.; Oglesby, C.S.; Graham, W.G.; Clark, M.; McFarland, R.H.; Morgan, T.J.; Stockli, M.P.; Berkner, K.H.; Johnson, B.M. (Western Michigan Univ., Kalamazoo (USA). Dept. of Physics; New Univ. of Ulster, Coleraine (UK). Dept. of Physics; North Carolina Univ., Chapel Hill (USA). Dept. of Physics; Missouri Univ., Rolla (USA). Dept. of Physics; Wesleyan Univ., Middletown, CT (USA). Dept. of Physics; Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-83ER13116;AC02-76CH00016. 18p. (CONF-841117—28). NTIS, PC A02/MF A01; GPO Dep. File Number DE85005132.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

Significant new evidence is presented for resonant-transfer-and-excitation (RTE) in ion-atom collisions. This process occurs when a target electron is captured simultaneously with the excitation of the projectile followed by deexcitation via photon emission. RTE, which is analogous to dielectronic recombination (DR), proceeds via the inverse of an Auger transition, and is expected to be resonant for projectile velocities corresponding to the energy of the ejected electron in the Auger process. RTE was investigated by measuring cross sections for projectile K x-ray emission coincident with single electron capture for 15 to 200 MeV $_{16}S^{13+}$, 100 to 360 MeV $_{20}Ca^{16+\ 17+\ 18+}$ and 180 to 460 MeV $_{23}V^{19+\ 20+\ 21+}$ ions colliding with helium. Strong resonant behavior, in agreement with theoretical calculations of RTE, was observed in the coincidence cross sections.

10493 **(CONF-841117—32) Theory of K/sup n/L/sup v/ multiple vacancy production by heavy ions.** Becker, R.L.; Ford, A.L.; Reading, J.F. (Oak Ridge National Lab., TN (USA); Texas A and M Univ., College Station (USA)). 1984. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004443.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

Observation of intensities of K/sub α/ x-ray or Auger satellites and hyper-satellites together with fluorescence yields provides knowledge of KL/sup v/ and K²l/sup v/ vacancy distributions produced by ion-atom collisions. The traditional theory used since ~ 1972 employs a single-particle model and a weak-coupling ionization approximation. We review our recent extensions of the theory to include Paul correlations in the independent Fermi particle model, a unitary collision theory in the first Magnus and coupled-channels approximations, electron transfer to the projectile, and contributions from shakeoff which interfere with the collision-induced amplitudes.

10494 **(CONF-8408110—4) Vacancy-rearrangement theory in the first Magnus approximation.** Becker, R.L. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004435.

From 2. workshop on high-energy ion-atom collision processes; Debrecen, Hungary (27 Aug 1984).

In the present paper we employ the first Magnus approximation (M1A), a unitarized Born approximation, in semiclassical collision theory. We have found previously that the M1A gives a substantial improvement over the first Born approximation (B1A) and can give a good approximation to a full coupled channels calculation of the mean L-shell vacancy probability per electron, p/sub L/, when the L-vacancies are accompanied by a K-shell vacancy (p/sub L/ is obtained experimentally from measurements of K/sub α/-satellite intensities). For sufficiently strong projectile-electron interactions (sufficiently large Z/sub p/ or small v) the M1A ceases to reproduce the coupled channels results, but it is accurate over a much wider range of Z/sub p/ and v than the B1A. 27 references.

10495 **(LBL—18594) Full coupled cluster singles, doubles and triples model for the description of electron correlation.** Hoffmann, M.R. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 114p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85004657.

Thesis.

Equations for the determination of the cluster coefficients in a full coupled cluster theory involving single, double and triple cluster operators with respect to an independent particle reference, expressible as a single determinant of spin-orbitals, are derived. The resulting wave operator is full, or untruncated, consistant with the choice of cluster operator truncation and the requirements of the connected cluster theorem. A time-independent diagrammatic approach, based on second quantization and the Wick theorem, is employed. Final equations are presented that avoid the construction of rank three intermediary tensors. The model is seen to be a computationally viable, size-extensive, high-level description of electron correlation in small polyatomic molecules.

10496 **(N—84-20632) Test bed ion engine development. Final Report, September 1982-November 1983.** Aston, G.; Deininger, W.D. (Jet Propulsion Lab., Pasadena, CA (USA)). Mar 1984. 79p. (NASA-CR—174623). NTIS, PC A05/MF A01.

A test bed ion (TBI) engine was developed to serve as a tool in exploring the limits of electrostatic ion thruster performance. A description of three key ion engine components, the decoupled extraction and amplified current (DE-AC) accelerator system, field enhanced refractory metal (FERM) hollow cathode and divergent line cusp (DLC) discharge chamber, whose designs and operating philosophies differ markedly from conventional thruster technology is given. Significant program achievements were: (1) high current density DE-AC accelerator system operation at low electric field stress with indicated feasibility of a 60 mA/sq cm argon ion beam (2) reliable FERM cathode start up times of 1 to 2 secs. and demonstrated 35 ampere emission levels (3) DLC discharge chamber plasma potentials negative of anode potential and (4) identification of an efficient high plasma density engine operating mode. Using the performance projections of this program and reasonable estimates of other parameter values, a 1.0 Newton thrust ion engine is identified as a realizable technology goal. Calculations show that such an engine, comparable in beam area to a J series 30 cm thruster, could, operating on Xe or Hg, have thruster efficiencies as high as 0.76 and 0.78 respectively, with a 100 eV/ion discharge loss.

10497 **(N—84-25459) Dependence of the backscattering coefficients of light ions upon angle of incidence.** Tabata, T.; Ito, R.; Itikawa, Y.; Itoh, N.; Morita, K.; Tawara, H. (Nagoya Univ. (Japan)). Feb 1984. 100p. (IPPJ-AM—34). NTIS, PC A05/MF A01.

The data on the dependence of the number-backscattering coefficient R(N) and the energy-backscattering coefficient R(E) of H, D, He-3 and He-4 ions upon the angle of incidence theta are compiled into tables. The compilation includes the data generated by computer simulation as well as those obtained experimentally. The references up to the middle of 1983 have been covered. Incident energies of the existing data range from 0.01 to 46 keV. Analytic formulas to express R(N) and R(E) as a function of theta are briefly reviewed. The data compiled are also shown in graphs together with the curves of new analytic formulas developed by the present authors.

10498 **(N—84-25460) Extraction of volume produced H(-) or D(-) ions from a sheet plasma 2.** Uramoto, J. (Nagoya Univ. (Japan)). Feb 1984. 34p. (IPPJ—666). NTIS, PC A03/MF A01.

A development to large area H(-) or D(-) ion source was tried by using three extraction electrodes: the first electrode bias voltage was set near the wall potential (floating), the second electrode was set near 13% of main extraction voltage and the third electrode was the main acceleration electrode. An ion current of 13 mA (3.3 mA/sq cm) for H(-) or 11 mA (2.8 mA/sq cm) for D(-) at 3 keV was extracted from 9 apertures of 6 mm-phi in 4 sq cm outside of the sheet plasma (14 cm wide and 1.0 cm thick) under a pressure of 7.7 x 10(-4) Torr H2 or D2 gas and a weak magnetic

field 50 gauss. Then, it was noted that the corresponding electron current was suppressed below 1/10 of the H(-) or D(-) ion current.

10499 **(N—84-32130) Absolute photoionization cross sections of atomic oxygen.** Samson, J.A.R.; Pareek, P.N. (Nebraska Univ., Lincoln (USA)). 1982. 29p. (NASA-CR—173873). NTIS, PC A03/MF A01.

The absolute values of photoionization cross sections of atomic oxygen were measured from the ionization threshold to 120 A. An auto-ionizing resonance belonging to the 2S2P4(4P)3P(3Do, 3So) transition was observed at 479.43 A and another line at 389.97 A. The experimental data is in excellent agreement with rigorous close-coupling calculations that include electron correlations in both the initial and final states.

10500 **(N—84-32131) Optical Stark effect in the 2-photon spectrum of NO.** Huo, W.M.; Gross, K.P.; Mckenzie, R.L. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). Jul 1984. 20p. (NASA-TM—85964; A—9760). NTIS, PC A02/MF A01.

A large optical Stark effect has been observed in the two-photon spectrum X(2)Pi yields A(2)Sigma(+)← in NO. It is explained as a near-resonant process in which the upper state of the two-photon transition is perturbed by interactions with higher-lying electronic states coupled by the laser field. A theoretical analysis is presented along with coupling parameters determined from ab initio wave functions. The synthetic spectrum reproduces the major experimental features.

10501 **(N—84-33339) Atomic resonance and scattering.** Kleppner, D.; Pritchard, D.E.; Ahmad-Bitar, R.; Ducas, T.; Kelleher, D.; Ligare, M.; Lyyra, A.M.; Moskowitz, P.; Saenger, K.L.; Smith, N. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1984. 12p. NTIS, PC A12/MF A01.

In RLE program report No. 126, 7-8, N—84-33336 22-99.

Experiments were conducted in the following areas: mapping of energy levels of a Rydberg lithium atom in a strong magnetic field in the vicinity of a crossing between levels from different principle quantum numbers, electrodynamics in a cavity, resonance enhanced multiphoton ionization, velocity dependence of rotational rainbow structure in Na2-Ar, high precision mass measurement on single ions using cyclotron resonance, low temperature energy transfer, trapping of neutral atoms, and vibrationally inelastic collisions.

10502 **(N—84-33341) X-ray diffuse scattering.** Birgeneau, R.J.; Kortan, A.R.; Sutton, M.; Evans-Lutterodt, K.; Hong, J.; Martinez-Miranda, L.J.; Mochrie, S.G.J.; Ocko, B.M.; Specht, E. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1984. 4p. NTIS, PC A12/MF A01.

In RLE program report No. 126, 23-26, N—84-33336 22-99.

Modern X-ray scattering techniques are used to study the structures and phase transitions in novel states of condensed matter. Synchrotron radiation is used to study structure and transitions occurring at single surfaces. Current experiments are concentrated in three areas: the growth, structure, and phase transitions of intercalant materials, most especially bromine-intercalated graphite, the structure and phase transitions of smectic liquid crystals, and the evolution from thin film to bulk structures of model systems.

10503 **(N—84-33352) Photon correlation spectroscopy and applications.** Chen, S.H.; Kotlarchyk, M.; Chao, Y.S.; Lin, C.L.; Mizumoto, C.; Sheu, E. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1984. 2p. NTIS, PC A12/MF A01.

In RLE program report No. 126, 83-84, N—84-33336 22-99.

A high resolution spectroscopic technique based on scattered light intensity fluctuation measurement was in use for some time. A variation of the digital time-domain pulse correlation technique using a 256-channel clipped correlator was developed. The correlator-multichannel memory system is controlled by a PDP 11/MINC computer system which is capable of high speed data acquisition and analysis necessary for the study of time-varying phenomena. Theoretical methods were developed to analyze quasi-elastic, light-scattering spectra from cells undergoing Brownian motions of self-propelled motions in liquid media. The methods were tested successfully with a model bacterium Eschericia coli, and the applicability of the model calculation to cells of dimensions of the order of a micron was ascertained.

10504 **(PB—84-231398) Some aspects of electron-atom collisions: elastic and non-elastic case.** Jouffrey, B. (Centre National de la Recherche Scientifique, 31 - Toulouse (France). Lab. d'Optique Electronique). 1982. 108p. (In French). NTIS, PC E06/MF E06.

The energy losses and electron-atom interactions are quite diverse and complex. We have developed here only limited aspects, leaving aside, for example, the problems concerning bremsstrahlung, the Cerenkov effect, the transition radiation, pipe system radiation. Concerning the latter point, a special issue of 'Radiation Effects' has been issued recently. An article concerning electron microscopy can be found in the Antwerp Congress on high voltage (C. Humphreys). F. Fujimoto has equally considered the theory of this effect. We have, in addition, dealt on the basis of the problem of energy losses from IM - (1/epsilon) with the function of energy loss.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 64042010328, 10610

10505 **(LA—10202-MS) Thermal conductivity of an arbitrarily dense plasma.** Rinker, G. (Los Alamos National Lab., NM (USA)). Oct 1984. Contract W-7405-ENG-36. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85005193.

This is the second in a series of reports concerning the transport properties of dense plasmas. In this work, we use the formalism of Lampe to extend our previous calculations of electrical conductivity to the calculation of thermal conductivity and thermoelectric coefficient. Quantitative results are given for iron at temperatures ranging from 10^{-2} to 10^{4} eV and for densities from 3 x 10^{-4} to 10^{5} g/cm^{3}.

10506 **(N—84-26409) Particle acceleration by turbulent magnetohydro-dynamic reconnection.** Matthaeus, W.H.; Ambrosiano, J.J.; Goldstein, M.L. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jun 1984. 16p. (NASA-TM—86121). NTIS, PC A02/MF A01.

Test particles in a two dimensional, turbulent MHD simulation are found to undergo significant acceleration. The magnetic field configuration is a periodic sheet pinch which undergoes reconnection. The test particles are trapped in the reconnection region for times of order an Alfven transit time in the large electric fields that characterize the turbulent reconnection process at the relatively large magnetic Reynolds number used in the simulation. The maximum speed attained by these particles is consistent with an analytic estimate which depends on the reconnection electric field, the Alfven speed, and the ratio of Larmor period to the Alfven transit time.

6450 High Energy Physics

10507 **Intersections between particle and nuclear physics.** Mischke, R.E. (ed.). New York, NY; American Institute of Physics (1984). 1199p. (CONF-8405193—). American Institute of Physics, 335 E. 45th Street, New York, NY 10017. File Number TI85004178. Contract W-7405-ENG-36.

From Conference on the intersections between particle and nuclear physics; Steamboat Springs, CO, USA (23 May 1984).

Separate entries were prepared for the data base for the papers presented. (WHK)

6451 Particle Interactions And Properties - Experimental

10508 **(BNL—35488) Preliminary results on single spin asymmetry measurements in inclusive p + p reactions at high P/sub perpendicular to/ and 16.5 GeV/c.** Barton, D.; Bunce, G.; Carroll, A.; Makdisi, Y.; Remsberg, L.; Baller, B.; Benson, R.; Courant, H.; Heller, K.; Heppelmann, S. (Brookhaven National Lab., Upton, NY (USA); Minnesota Univ., Minneapolis (USA); Southeastern Massachusetts Univ., North Dartmouth (USA)). 1984. Contract AC02-76CH00016. 7p. (CONF-8409162—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004190.

From 6. international symposium on high energy spin physics; Marseille, France (12 Sep 1984).

Preliminary results are presented on the scattering asymmetries of pions, kaons, and protons produced inclusively from a 16.5 GeV/c polarized proton beam incident on an unpolarized hydrogen target. The data are for transverse momenta between 1.0 and 2.7 GeV/c and X/sub F/ near zero. 8 references.

10509 **(DOE/ER/01195—491) Observation of eta-c and other structures in the radiative decay psi to gamma eta pi-plus pi-minus.** Becker, J.J. (Illinois Univ., Urbana (USA). Dept. of Physics). 1984. Contract AC02-76ER01195. 138p. (COO—1195-491). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85000715.

The Mark III detector at SPEAR was used to observe the exclusive radiative decay psi $\rightarrow \gamma$ eta $\pi^+\pi^-$. The eta c was seen as an intermediate state in this decay, psi $\rightarrow \gamma$ eta c, eta c $\rightarrow$ eta $\pi^+\pi^-$. The product branching ratio B(psi $\rightarrow \gamma$ eta c) B(eta c $\rightarrow$ eta $\pi^+\pi^-$) was measured to be 4.2 +- 0.5 (stat) +- 0.5 (sys) x 10^{-4}. Other resonant structure was observed in the eta $\pi^+\pi^-$ spectrum in the range 1 < M/sub eta $\pi^+\pi$-/ < 2 GeV/c^2, which appears to decay via X $\rightarrow \delta^{+-}\pi^{-+}$, delta^{+-} $\rightarrow$ eta π^{+-}. A spin-parity analysis was performed to determine the quantum numbers of the resonances responsible for this structure. However, the result was seen to be model dependent, so that it was not possible to conclusively resolve the underlying structure in the spectrum. No evidence was seen for the decay iota $\rightarrow$ eta $\pi^+\pi^-$. An upper limit was set for the ratio of branching ratios for iota $\rightarrow$ eta $\pi\pi$ relative to iota $\rightarrow$ KKπ, R = B(psi $\rightarrow \gamma$iota)B(iota $\rightarrow$ eta $\pi\pi$)/B(psi $\rightarrow \gamma$iota)B(iota $\rightarrow$ KKπ) < 0.2 (90% C.L.). 54 references, 59 figures.

10510 **(DOE/ER/05001—6) High energy channeling and application. Progress report, November 1, 1983-October 30, 1984.** Gibson, W.M.; Sun, C.R. (State Univ. of New York, Albany (USA). Dept. of Physics). 6 Dec 1984. Contract AC02-78ER05001. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004994.

New research using CLEO detector at Cornell synchrotron has started this year, studying B-meson physics. At Fermilab, particles at highest energy (400 GeV) has been steered through a crystal septum for the first time. At SLAC, both the dipole and the new electron synchrotron radiation has been observed. New crystal assisted pair production processes and channeling radiation up to 150 GeV were reported. 17 references.

10511 **(DOE/ER/10667—T2) Task A: direct photon production (R807/808) and lepton production (NA34). Task B: direct photon production at the Tevatron (E-706). Task C: search for fractional charge particles in semiconductors. Progress report, June 1, 1984-May 31, 1985.** Cleland, W.E.; Coon, D.D.; Engels, E. Jr.; Shepard, P.F.; Thompson, J.A. (Pittsburgh Univ., PA (USA). Dept. of Physics and Astronomy). Dec 1984. Contract AC02-80ER10667. 122p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85005202.

Task A started as the support of Pitt contingent of the Axial Field Spectrometer Collaboration, performing experiment R807/808 at CERN. Last year we joined a collaboration which was formed around the same basic group to perform an experiment at the SPS, using many of the R807/808 components to set up an experiment to study lepton production (NA34). We are therefore involved both in the setting up of the new experiment, for which we have taken a major responsibility for the trigger system, and in the analysis of data from the AFS experiment. The R807/808 experiment has probed several topics related to study of high P/sub T/ phenomena such as production of jets at high E/sub T/ [1, 2, 3, 4] and a comparison of their properties with jets seen in e^+e^-. Task B supports the Pitt contingent of the E706 collaboration, which is studying prompt photon production in πp and pp collisions at the Tevatron. The major contribution of the Pitt effort to the experiment is the provision of the array of semiconductor detectors required for the charged particle spectrometer to be used in the study of correlated hadronic jets. Because of the physics overlap between tasks A and B, our active participation in R807/808 strengthens our contribution to E706. In particular, the πp/pp comparison in E706 complements the anti pp/pp comparison in R807/808. Task C is the search for fractional-charge in semiconductors. The major effort is the development of a new experimental technique which combines field ionization and low background infrared spectroscopy using a liquid helium cooled monochromator and a computer controlled data acquisition. 87 references.

10512 **(LBL—18341) Search for fractionally charged particles in e^+e^- annihilations.** Huth, J.E. (Lawrence Berkeley Lab., CA (USA)). Sep 1984. Contract AC03-76SF00098. 152p. NTIS, PC A08. File Number DE85004659.

We have searched for the production of free Q = +-1/3e, Q = +-2/3e and Q = +-4/3e particles produced in e^+e^- collisions at a center-of-mass energy of 29 GeV in 77 pb^{-1} of data collected by the time projection chamber at PEP. No evidence has been found for the production of these particles. Upper limits are established on the inclusive cross section for the production of Q = +-1/3e, Q = +-2/3e, and Q = +-4/3e particles in the mass range 1.0 to 13 GeV/c^2, improving upon previously established limits. 58 references.

10513 **(LBL—18479) Searching for supersymmetry at the SSC.** Dawson, S.; Savoy-Navarro, A.; Alverson, G.; Barnett, R.M.; Fernandez, E.; Freeman, J.; Gladney, L.; Haber, H.; Lynn, S.; Paige, F. (Lawrence Berkeley Lab., CA (USA); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Northeastern Univ., Boston, MA (USA); Colorado Univ., Boulder (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Stanford Linear Accelerator Center, CA (USA)). Oct 1984. Contract AC03-76SF00098. 36p. (CONF-8406198—29). NTIS, PC A03. File Number DE85004897.

From Design and utilization of the superconducting super collider summer study; Snowmass, CO, USA (23 Jun 1984).

Supersymmetric (SUSY) models have generated increasing amounts of attention in recent years as a means of understanding the roles of scalar particles in a field theory. Since supersymmetry connects fermions and bosons in a natural framework, theorists are hopeful that it will reduce the freedom surrounding fermions and scalars in the Weinberg-Salam model. No satisfactory model exists at this time, but the structure of the supersymmetric algebra is sufficiently attractive to warrant a serious study of its consequences. It is possible to make a great many predictions which are independent of the choice of a specific model. In this report we make a detailed attempt to study the experimental problems posed by supersymmetric theories and to analyze the capabilities of an SSC to find the many new particles predicted by these theories. The plan of this report is as follows. The present theoretical situation of supersymmetric phenomenology is discussed, and the results contained in the literature are briefly reviewed. The experimental signatures for the production of various SUSY particles are examined with varying assumptions about the SUSY masses and decay scenarios. The background from known physics to events containing the new SUSY particles is discussed. We pay particular attention to the two jet background. A discussion of the characteristics of events containing SUSY particles is given, including the E/sub t/ missing spectra and the average number of jets per event. Trigger requirements necessary to identify SUSY particles are considered. The results of two detector simulations are presented: one is a classical 4π detector for which we have used the CDF simulation package and the other is a simple 4π calorimeter. Finally, a Monte Carlo written by R.M. Barnett and H. Haber is discussed, and their results are compared with those obtained from ISAJET. 14 references, 30 figures.

10514 Energy dependence of the 90° pp elastic scattering depolarization parameter and amplitudes between 0.9 and 1.5 GeV/c. Hollas, C.L.; Cremans, D.J.; Ransome, R.D.; Riley, P.J.; Bonner, B.E.; McNaughton, M.W.; Wood, S. (Texas Univ., Austin). *Physics Letters, [Section] B;* **143**: No. 4-6, 343-346(16 Aug 1984).

The depolarization parameter Dsub(NN) for pp elastic scattering at thetasub(cm) = 90° has been measured at twelve momenta between 0.9 and 1.5 GeV/c. The moduli of the three transversity amplitudes T_1, T_3, and T_4 have been extracted from these data and from previous measurements of the differential cross section and spin correlation parameter Asub(NN)(90°). Smooth energy dependence is found for all three amplitude moduli.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 64520010522

10515 (DOE/ER/03285—47) Research in theoretical physics. Annual progress report, April 1, 1983-March 31, 1984. Domokos, G.; Koevesi-Domokos, S. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Physics and Astronomy). Nov 1984. Contract AC02-76ER03285. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004286.

A dynamical model of the family structure of quarks and leptons was investigated in the context of a spontaneously broken local family symmetry. General results were obtained concerning the structure of gauge theories with a dynamically broken symmetry. Measurement of magnetic moments of heavy quarks and leptons is proposed in order to discover their conjectured substructure. 23 references.

10516 (DOE/ER/40160—1) High energy hadron-hadron collisions. Annual progress report. Chou, T.T. (Georgia Univ., Athens (USA). Dept. of Physics). Dec 1984. Contract FG09-84ER40160. 18p. NTIS, PC A02. File Number DE85005004.

Work on high energy hadron-hadron collisions in the geometrical model is summarized. Our recent investigation has centered on the analysis of new experimental results obtained at the CERN-SPS Collider. Specific items studied include the analysis of anti pp elastic scattering and particle production processes with the geometrical picture. As a result of the latter study, a model for particle production is proposed and a simple compact formula for single-particle momentum distribution obtained. The calculated angular distribution is in excellent agreement with the SPS Collider experiments. 28 references.

10517 (IS-T—1102) Theoretical study of parton fragmentation and evolution into hadrons. Ng, A.H. (Ames Lab., IA (USA)). Dec 1984. Contract W-7405-ENG-82. 195p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85005136.

In the first part of this work, we used the technique of Monte Carlo simulation to conduct a detailed investigation of jet-like structures which are expected to arise in hard scattering processes, and subsequently fragmentation of energetic partons in hadron-hadron collision, deep inelastic lepton-nucleon scattering or electron-positron annihilation. We believe from this work that the present status of QCD Monte Carlo simulation techniques is developed enough to lead to new depth in the understanding of jet phenomena. Our work indicates that one can identify jets by studying the P/sub T/ distributions, mass distributions, multiplicities, and energy flow. Some information relevant to the kinematical constraints can also be obtained from the simulation method to aid the experimental set-up of the detectors for the study of QCD in γN reactions in future experiments. In the second and major part of the present work, a theoretical QCD model based on summing leading-logarithmic expressions was developed to study inclusive single-particle and two-particle production in parton jets. This work was done to gain understanding of the behavior of quark and gluon fragmentation functions, emphasizing longitudinal momentum and Q^2 dependence. We have given a general prescription for obtaining multiparton distribution functions from jet calculus combined with bound state form factor (called the recombination function) information in a manner similar to the functions used by Migneron, Jones and Lassila for baryon production. With these jet calculus multiparton distribution functions and recombination functions, we have determined the quark and gluon fragmentation functions without the use of any phenomenological input parton (quark or gluon) fragmentation functions at some lower energy scale Q_0^2. 72 references.

10518 Skyrme model, the strong coupling theory and the static quark model. Bardakci, K. (Lawrence Berkeley Lab., CA). *Nuclear Physics [Section] B;* **243**: No. 2, 197-204(3 Sep 1984).

We show that to leading order in the quark number N, the Skyrme model, the strong coupling theory and the static quark model share a common underlying symmetry group.

10519 Absence of radiative mass shifts for composite Goldstone supermultiplets. Clark, T.E.; Love, S.T. (Purdue Univ., Lafayette, IN). *Physics Letters, [Section] B;* **143**: No. 4-6, 445-448(16 Aug 1984).

A supersymmetric Dashen type formula is used to prove that there are no radiative mass corrections for Goldstone pion supermultiplets due to gauge interactions. In particular, for unbroken supersymmetry the charged to neutral pion mass difference is shown to vanish to all orders in electromagnetism.

10520 Anomalous Z decays and g-2 of the electron. Suzuki, M. (Lawrence Berkeley Lab., CA). *Physics Letters, [Section] B;* **143**: No. 1-3, 237-240(9 Aug 1984).

If the leptonic Z decays with an energetic photon are interpreted as cascade decays through a new particle, a stringent constraint is imposed on the couplings by the measured value of the magnetic moment of the electron. In models with a fermion E, where Z -> eanti E(anti eE) -> eanti eγ, the constraint is avoided if Esub(R) and Esub(L) are either both singlets or both members of a doublet.

10521 Quark-antiquark charge distributions and confinement. Barad, K.; Ogilvie, M.; Rebbi, C. (State Univ. of New York, Stony Brook). *Physics Letters, [Section] B;* **143**: No. 1-3, 222-226(9 Aug 1984).

A simulation method for the direct analysis of the distribution of quarks inside a hadron is proposed. As an illustrative example, this method is applied to two-dimensional QCD.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 64530010523

10522 Low energy tests of conservation laws in particle physics. Blecher, M.; Gotow, K. (eds.). New York, NY; American Institute of Physics (1984). 335p. (CONF-8309163—). American Institute of Physics, 335 E. 45th Street, New York, NY 10017. File Number TI84012407.

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

The miniconference was held to review the current status of low energy and non-accelerator experiments as tests of conservation laws in particle physics. The emphasis, therefore, was on experimental work and a panel discussion was held at the end of the conference to project the future role of high sensitivity, high resolution experiments in particle physics. Separate abstracts were prepared for the 31 papers presented. (WHK)

6454 Field Theory

REFER ALSO TO CITATION(S) 64540010515

10523 Symmetries of massive fields in Kaluza-Klein supergravity. Dolan, L. (The Rockefeller University, New York, New York 10021). *Physical Review [Section] D: Particles and Fields;* **30**: No. 12, 2474-2481(15 Dec 1984). Contract AC02-81ER40033.

The infinite-parameter symmetry algebra of the massive tower of fields in five-dimensional N = 2 Kaluza-Klein supergravity compactified on $M^4 \times S^1$ is identified as a local version of the Kac-Moody extension of the super-Poincare algebra with central charge mixed with the Virasoro algebra. Most of the symmetry is spontaneously broken. The Goldstone (s = 1,0) bosons and (s = 1/2) fermions are identified, and the implication for the mass spectrum of the massive tower of fields is discussed.

10524 **Structure of techni jets.** Kolb, E.W.; McLerran, L. (Fermi National Accelerator Lab., Batavia, IL). *Physics Letters, [Section] B;* **143**: No. 4-6, 505-508(16 Aug 1984).

The properties of jets associated with quarks carrying a non-abelian gauge interaction which becomes strong at a momentum scale. Asub(TC), which is taken to be much larger than that appropriate for QCD, Asub(QCD), are studied. Such jets are shown to produce a unique experimental signal for new interactions.

10525 **Two-loop finite supersymmetric SU_5 theory: towards a theory of fermion masses.** Jones, D.R.T.; Raby, S. (Colorado Univ., Boulder). *Physics Letters, [Section] B;* **143**: No. 1-3, 137-141(9 Aug 1984).

We present a realistic two-loop finite supersymmetric grand unified theory. The gauge group is SU_5 and the low energy theory includes three families of quarks and leptons with the minimal Higgs doublet content. The most important feature of the model is the non-trivial constraint of finiteness on the quark and lepton masses. We find sin²thetasub(w) = 0.21 and msub(b)/msub(tau) = 1.8 (at Msub(w)) and predict a top quark mass of 155 GeV. Nucleon decay is dominated by colored Higgs triplet exchange with characteristic decay modes p -> $K^0\mu^+$, p -> K^+anti νsub(μ) and n -> K^0anti νsub(μ).

10526 **Dimensional reduction example with three families of low mass fermions.** Chapline, G.; Grossmann, B. (Lawrence Livermore National Lab., CA). *Physics Letters, [Section] B;* **143**: No. 1-3, 161-164(9 Aug 1984).

We show that dimensional reduction of a supersymmtric E_8 Yang-Mills theory in ten dimensions can lead to a flavor-chiral SU(5)XSU(3)XU(1) Yang-Mills-Higgs theory in four dimensions where three anti 5+10 fermion families are massless in the absence of representation mixing. When representation mixing is taken into account only the u-quarks can acquire a mass comparable to the W-mass.

10527 **Bootstrap theory of particles.** Capra, F.J. (Lawrence Berkeley Lab., CA). *Surveys in High Energy Physics;* **4**: No. 3, 127-202(Mar 1984).

Recent developments in S-matrix theory are reviewed which have resulted in a topological bootstrap theory of particles. Each component of an S-matrix topological expansion is associated with a pair of intersecting surfaces: a classical surface describing space-time aspects of particle interactions, and a quantum surface carrying the internal quantum numbers. The theory implies a definite and restricted set of elementary particles, all of which are composite structures built from two kinds of topological constituents that are not themselves particles. One of the two constituents is identified with topological quarks, which appear in 3 colors, 8 flavors, and with integral charges. The lowest level of the topological expansion exhibits a topological supersymmetry involving a single dimensionless coupling constant that has been identified tentatively with the fine-structure constant.

65 PHYSICS. II.

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 65100010507

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 65110010567

10528 (BNL—51778, pp 503-535) **Spins and moments of fission product nuclei.** Ekstroem, C. (Studsvik Science Research Lab., Nykoeping, Sweden). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Experimental data on nuclear spins and moments are of great importance in testing the applicability of different theoretical approaches to nuclear structure. Directly measured spin values also serve as a basis for spin assignments of excited nuclear states. The present paper reports on experimental methods adapted to on-line measurements of nuclear spins and moments of short-lived nuclides far from stability, and gives a discussion of the data obtained in the N > 50 and N > 82 fission product regions. Finally, the prospects for future extensions are indicated.

10529 (BNL—51778, pp 365-393) **Measuring delayed neutron spectra - a comparison of techniques.** Greenwood, R.C.; Caffrey, A.J. (Idaho National Engineering Lab., Idaho Falls). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—). Contract AC07-76ID01570.

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Currently, there are three quite different techniques that are in general use for measurement of delayed-neutron energy spectra from fission-product precursor isotopes. These three techniques use ^{3}He gas-filled gridded ionization chambers, proton-recoil proportional counters and neutron time-of-flight, respectively. Since there now exists a sufficient body of experimental data, especially for several of the Rb and Cs precursor isotopes, measured using each of these techniques, a meaningful intercomparison of the quality of data and range of applicability for each technique is now possible. Such an intercomparison is the subject of this paper.

6512 Nuclear Properties And Reactions, A=1-5

10530 **Electroproduction of low energy pions from deuterium.** Franklin, G.B.; Bernstein, A.M.; Blomqvist, K.I.; Dytman, S.A.; Paras, N.; Pauli, M.; LeRose, J.; Min, K.; Rowley, D.; Sapp, B.O. . (Physics Department and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 5, 1632-1637(Nov 1984). Contract AC02-76ER03069.

The inclusive electroproduction of 30 MeV π^+ and π^- mesons has been observed at a laboratory angle of 90° for electron energies from 185 MeV (the kinematic threshold) to 235 MeV. Measurements of the yield were performed and double differential cross sections for photoproduction were obtained using virtual-photon theory. A significant discrepancy between experiment and distorted-wave impulse approximation calculations was found. This is particularly surprising since these calculations agree with the total cross sections for the ^{2}H(γ,π^+)nn reaction from threshold to 20 MeV above threshold.

10531 **Faddeev Monte-Carlo calculations of trinucleon binding energy with three-body potentials.** Wiringa, R.B.; Friar, J.L.; Gibson, B.F.; Payne, G.L.; Chen, C.R. (Argonne National Lab., IL). *Physics Letters, [Section] B;* **143**: No. 4-6, 273-278(16 Aug 1984).

Monte Carlo integrations for binding energy and other expectation values in ^{3}H and ^{3}He using configuration-space Faddeev

wave functions are reported. Nine combinations of two- and three-nucleon potentials are tested, several giving a significant contribution of proportional 1 MeV to the binding energies from the three-nucleon potentials. The energy contribution of the three-nucleon potential is found to be very sensitive to form factor parameters and to small components of the Faddeev wave function. The influence of the three-nucleon potential on the wave function is investigated using a simple one-parameter variation of the Faddeev wave function.

6513 Nuclear Properties And Reactions, A=6-19

10532 (BNL—51778, pp 157-190) **Theories of β strength distribution in nuclei.** Takahashi, K. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

An introductory review of the study of β-strength distribution in nuclei is attempted from a mainly theoretical viewpoint. Some historical aspects of the developments having implied the possible existence of the Gamow-Teller giant resonance are detailed. It is then concluded that, owing to the recent experimental confirmation of the very existence, one now has a clear picture of the global structures of strength distributions at least for allowed β transitions. It is particularly stressed that the direct experimental confirmation has made finishing touches on reaching the consensus that such collectivities are largely (if not fully) responsible for the hindrance phenomena observed in β decays of heavy nuclei. Notwithstanding this remarkable success in the general understanding of the physics behind, much remains to be worked out and proven, it is argued, in order to gain a fully quantitative description of complex nuclear β-decay and related processses observed (or to be observed). In this respect, and in the light of the main topic of this meeting, it is emphasized that the temporal numerical success of a theoretical model with many parameters, in comparison with some selected pre-existing experimental data, does not necessarily claim the credit for the model's capability of reliably predicting β-decay properties of unknown nuclei, that is to a more or less great extent required for the applications in the various fields ranging from reactor technology, nuclear physics not to mention, as far as to astrophysics.

10533 (CONF-8411118—9) **Data for the neutron interactions with ^{6}Li and ^{10}B.** Poenitz, W.P. (Argonne National Lab., Idaho Falls, ID (USA)). 1984. Contract W-31-109-ENG-38. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005014.

From Meeting on nuclear standard reference data; Geel, Belgium (12 Nov 1984).

The ^{10}B(n,α), ^{10}B(n,α_1) and, increasingly in more recent measurement, the ^{6}Li(n,α) cross sections are the major references used in low energy experiments. Many data from modern measurements are available for the neutron interaction with ^{6}Li, including total, scattering, and absolute and relative (n,α) cross sections. A consensus has been reached with these new ^{6}Li + n data. In contrast, the data base for the ^{10}B neutron interaction cross sections is unfortunately poor. This is even the case for the total cross section which is supposed to be the easiest quantity to be measured. The most serious deficiency is the absence of data from absolute measurements of the ^{10}B(n,α) and ^{10}B(n,α_1) cross sections in the last 10 to 15 years. The available cross section data which were used for the ENDF/B-VI evaluation will be discussed. 43 references.

10534 **Isospin structure of transitions in ^{17}O from inelastic pion scattering at 164 MeV.** Blilie, C.L.; Dehnhard, D.; Franey, M.A.; Gay, D.H.; Holtkamp, D.B.; Seestrom-Morris, S.J.; Ellis, P.J.; Morris, C.L.; Millener, D.J. (University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 6, 1989-1998(Dec 1984).

Differential cross sections for inelastic scattering of π^+ and π^- from a cooled gas target, enriched in ^{17}O (49.9%), were measured at an incident energy T/sub π/ = 164 MeV between θ/sub lab/ = 18° and 74°. Data were also taken on a natural oxygen and an enriched ^{18}O target (94.9%) to allow a subtraction of the ^{16}O and ^{18}O yields from the data taken with the ^{17}O target. A microscopic distorted wave impulse approximation analysis of five collectively enhanced transitions to the lowest J/sup π/ = (3/2)$^-$, (5/2)$^-$, (7/2)$^-$, (9/2)$^-$, and (11/2)$^-$ states in ^{17}O was performed using transition densities from three different models. The data were fitted best with transition densities derived from a large-space shell-model calculation; provided that their [LSJ] = [303], isoscalar parts were enhanced by a factor (1+2δ). Both the π^+ and π^- data for the five transitions in ^{17}O and the transition to the 3$^-$ state in ^{16}O (6.13 MeV) were fitted using a single polarization charge, δ. Evidence was found for E2 strength near 8 MeV and for M4 strength to two states at 15.7 and 17.1 MeV.

10535 **Observation of angular momentum saturation in deep-inelastic processes involving light heavy ions.** Shapira, D.; Shull, D.; Ford, J.L.C. Jr.; Shivakumar, B.; Parks, R.L.; Cecil, R.A.; Thornton, S.T. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review Letters;* **53**: No. 17, 1634-1637(22 Oct 1984). Contract AC05-84OT21400;AC02-76ER03074.

The most probable value for the total kinetic energy of reaction products from strongly damped collisions of ^{28}Si+ ^{12}C was found to increase with bombarding energy only up to a limiting value. This behavior suggests that the orbital angular momentum of the dinuclear complex formed in these collisions has reached a saturation value beyond which further increase is not possible.

10536 **^{22}Na production cross sections from the ^{19}F(α,n) reaction.** Norman, E.B.; Chupp, T.E.; Lesko, K.T.; Grant, P.J.; Woodruff, G.L. (Nuclear Physics Laboratory, University of Washington, Seattle, Washington 98195 and Physics Department, Seattle University, Seattle, Washington 98122). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 4, 1339-1340(Oct 1984).

The thick-target neutron yield from the ^{19}F(α,n) reaction has been measured in 0.25-MeV steps over the energy range 3.5< or =E/sub α/< or =10.0 MeV. From these measurements, ^{22}Na production cross sections have been deduced. These cross sections are compared with the results of a Hauser-Feshbach calculation and with the results of previous experimental investigations.

10537 **^{13}C(p,p')^{13}C /sup / reaction at T/sub p/ = 547 MeV.** Seestrom-Morris, S.J.; Franey, M.A.; Dehnhard, D.; Holtkamp, D.B.; Boudrie, R.L.; Amann, J.F.; Idzorek, G.C.; Goulding, C.A. (University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 270-278(Jul 1984).

Differential cross sections and analyzing powers have been measured between θ/sub lab/ = 6.5° and 34.5° for scattering of 547-MeV polarized protons from ^{13}C. Data for the (1/2)$^-$ (0.0), (1/2)$^+$ (3.09), (3/2)$^-$ (3.68), (5/2)$_1^+$ (3.85), (5/2)$_2^+$ (6.86), (5/2)$^-$ (7.55), 1/2$_2^-$ (8.86), and (9/2)$^+$ (9.50) states are presented. The elastic scattering data were analyzed with a potential calculated in the impulse approximation and the resulting distorted waves were used in the distorted-wave impulse approximation analysis of the inelastic data with microscopic transition densities based on shell model wave functions.

6514 Nuclear Properties And Reactions, A=20-38

10538 **Pion and proton "temperatures" in relativistic heavy-ion reactions.** Brockmann, R.; Harris, J.W.; Sandoval, A.; Stock, R.; Stroebele, H.; Odyniec, G.; Pugh, H.G.; Schroeder, L.S.; Renfordt, R.E.; Schall, D.; Bangert, D.; Rauch, W.; Wolf, K.L. (Gesellschaft fuer Schwerionenforschung, D-6100 Darmstadt, West Germany). *Physical Review Letters;* **53**: No. 21, 2012-2015(19 Nov 1984).

Pion and proton production are measured to investigate thermal equilibrium in central collisions of ^{40}Ar+KCl at 1.8 GeV/nucleon. The bulk of the pion yield is found to be isotropic in the c.m. system, with an apparent temperature of 58 +- 3 MeV, much lower than the 118 +- 2 MeV of the protons. It is shown that the low pion "temperature" can be explained by the kinematics of the decay of delta resonances in thermal equilibrium. A (5 +- 1)% iso-

tropic component in the pion spectrum is, however, found to have a temperature of 110 +- 10 MeV, near that of the protons and Δ's. The effect on the spectra of possible contributions from collective radial is discussed.

10539 **Elastic and inelastic neutron scattering from ^{27}Al at 11, 14, and 17 MeV.** Whisnant, C.S.; Dave, J.H.; Gould, C.R. (North Carolina State University, Raleigh, North Carolina 27695 and Triangle Universities Nuclear Laboratory, Duke Station, Durham, North Carolina 27706). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 5, 1435-1441(Nov 1984).

Fast neutron scattering cross sections have been measured for ^{27}Al using a neutron time-of-flight facility. Angular distributions were measured at angles from 20° to 160° in 5° increments, at incident neutron energies of 11, 14, and 17 MeV. Data are presented for elastic scattering and for inelastic scattering to the sum of the 0.84 and 1.01 MeV states, the 2.21 MeV state, and the sum of the 2.73, 2.98, and 3.00 MeV states. After correcting for compound nucleus effects, the elastic scattering cross sections are well reproduced by the spherical optical model using a linear energy dependence in the real well depth. The inelastic data are interpreted with a coupled channels calculation and the excited core model.

10540 **Excitation functions of pion single charge exchange reactions in ^{27}Al, ^{45}Sc, and ^{65}Cu.** Rundberg, R.S.; Dropesky, B.J.; Giesler, G.C.; Butler, G.W.; Kaufman, S.B.; Steinberg, E.P. (Isotope and Nuclear Chemistry Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 5, 1597-1603(Nov 1984).

The cross sections for the pion single charge exchange reactions ^{27}Al(π^-,π^0) ^{27}Mg, ^{45}Sc(π^+,π^0) ^{45}Ti, and ^{65}Cu(π^-,π^0) ^{65}Ni were measured at pion kinetic energies from 80 to 400 MeV by activation techniques. The excitation functions measured for these target nuclei do not show any structure near the (3,3) resonance, but rather, all exhibit a monotonic decrease in cross section over this energy range, proportional to T/sub π/$^{-1}$. Theoretical predictions based on the impulse approximation with the Fermi gas model show a minimum near the (3,3) resonance, in disagreement with these experimental results.

10541 **^{36}S(n,γ) ^{37}S reaction with thermal neutrons and decay of ^{37}S to levels in ^{37}Cl.** Raman, S.; Ratynski, W.; Jurney, E.T.; Bunker, M.E.; Starner, J.W. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 1, 26-30(Jul 1984).

The ^{36}S(n,γ) ^{37}S reaction with thermal neutrons has been studied utilizing a highly enriched ^{36}S target. Fifteen γ rays were observed which have been incorporated into a ^{37}S level scheme. The neutron separation energy of ^{37}S was determined to be 4303.52 +- 0.12 keV; and the thermal neutron capture cross section of ^{36}S to be 230 +- 20 mb. The subsequent β^- decay of ^{37}S to levels in ^{37}Cl has also been studied. Seven γ rays were observed which have led to an improved ^{37}S decay scheme.

6515 Nuclear Properties And Reactions, A=39-58

10542 **Experimental location of Gamow-Teller strength for astrophysical calculations in the region of A = 54—58.** Ajzenberg-Selove, F.; Brown, R.E.; Flynn, E.R.; Sunier, J.W. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 6, 1850-1854(Dec 1984).

The (t,^{3}He) charge exchange reaction has been used to locate Gamow-Teller states with T_0+1 isospin in the region of A = 54—58. These data were obtained at E/sub t/ = 25 MeV on targets of /sup 54,56,58/Fe and ^{58}Ni.

10543 **Single particle effects in precompound reactions.** Scobel, W.; Blann, M.; Komoto, T.T.; Trabandt, M.; Grimes, S.M.; Hansen, L.F.; Wong, C.; Pohl, A.B.A. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 5, 1480-1492(Nov 1984).

Double differential cross sections have been measured with time of flight techniques at 16 angles between 3.5° and 159° (lab) for the inclusive production of neutrons from reactions of 25 MeV protons with /sup 50,52,53/Cr, /sup 54,56,58/Fe, ^{59}Co, ^{60}Ni, ^{63}Cu, ^{89}Y, /sup 90,91,92,94/Zr, /sup 92,94,95,96,97,98,100/Mo, ^{110}Pd, and ^{159}Tb and of 18 MeV protons with /sup 90,91,92,94/Zr. The spectra from /sup 90,91,92,94/Zr targets are compared with qualitative and quantitative predictions based on proton-particle—neutron-hole state densities generated from different sets of single particle states using the recursion method of Williams et al. An end point gap of nearly 4 MeV in the ^{91}Zr(p,n) spectrum may be understood quantitatively in terms of such an extreme single particle model argument. The experimental peak structure shows reasonably good agreement with the calculated results. It is shown that precompound spectra exhibit pronounced structure which is dependent upon nuclear structure effects for near closed shell nuclei, and that these effects should and do disappear rapidly with nuclear deformation, as predicted earlier by Williams et al.

6516 Nuclear Properties And Reactions, A=59-89

10544 **High-spin-state spectroscopy with the reaction ^{88}Sr(p/sub pol/,π^-)^{89}Zr.** Green, M.C.; Brown, J.; Jacobs, W.W.; Korkmas, E.; Throwe, T.G.; Vigdor, S.E.; Ward, T.E.; Jolivette, P.L.; Brown, B.A. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **53**: No. 20, 1893-1896(12 Nov 1984). Contract W-31-109-ENG-38.

The pronounced selectivity of near-threshold (p,π^-) reactions for high-spin two-particle, one-hole states is exploited, in the first spectroscopic application of a (p,π) reaction, to identify previously unknown 25/2$^+$ and 21/2$^+$ (g/sub 9/2/)^3 states in ^{89}Zr. Relative cross sections for the two transitions are well reproduced by simple model calculations. The analyzing power for the 25/2$^+$ state is markedly similar to previous (p/sub pol/,π^-) results for two-particle one-hole stretched states in lighter nuclei.

10545 **Absolute pair production cross section measurements in Z=82 with 1.077 MeV photons.** Avignone, F.T. III; Barker, C.W.; Miley, H.S.; O'Brien, H.A. Jr.; Steinkruger, F.J.; Wanek, P.M. (South Carolina Univ., Columbia). *Physics Letters* [*Section*] *A;* **104**: No. 3, 143-145(20 Aug 1984).

The absolute cross section for the production of electron-positron pairs by 1.077 MeV photons on lead was measured as 2.04 +- 0.10 mb. The ratio sigma(exp)/sigma(theor) = 1.5. This reprents the closest to threshold measurement for Z = 82.

6517 Nuclear Properties And Reactions, A=90-149

REFER ALSO TO CITATION(S) 65171010453, 10532, 10548, 10551, 10565

10546 (BNL—51778, pp 395-410) **Calculating β decay properties in the fission product region.** Mann, F.M. (Hanford Engineering Development Lab., Richland, WA). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Different theoretical models are described which are used in the prediction of β decay properties in the fission product region and comparison of results are made. Applications of such calculations are presented with emphasis on delayed neutron data.

10547 (BNL—51778, pp 411-422) **Analytical applications for delayed neutrons.** Eccleston, G.W. (Los Alamos National Lab., NM). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Analytical formulations that describe the time dependence of neutron populations in nuclear materials contain delayed-neutron dependent terms. These terms are important because the delayed neutrons, even though their yields in fission are small, permit con-

trol of the fission chain reaction process. Analytical applications that use delayed neutrons range from simple problems that can be solved with the point reactor kinetics equations to complex problems that can only be solved with large codes that couple fluid calculations with the neutron dynamics. Reactor safety codes, such as SIMMER, model transients of the entire reactor core using coupled space-time neutronics and comprehensive thermal-fluid dynamics. Nondestructive delayed-neutron assay instruments are designed and modeled using a three-dimensional continuous-energy Monte Carlo code. Calculations on high-burnup spent fuels and other materials that contain a mix of uranium and plutonium isotopes require accurate and complex information on the delayed-neutron periods, yields, and energy spectra. A continuing need exists for delayed-neutron parameters for all the fissioning isotopes.

10548 (BNL—51778, pp 191-226) **β-ray strength functions of far-unstable fission product nuclei.** Kratz, K.L. (Johannes Gutenberg-Universitaet Mainz, West Germany). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Experimental data on the β-strength function, S/sub β/(E), of short-lived, neutron-rich fission products are of importance for various problems in nuclear physics, astrophysics as well as for reactor applications. The present paper reports on experimental techniques to study the β-decay of nuclides far from stability and gives a comparison of recent data obtained in the A = 100 mass region with predictions from different nuclear models. It is demonstrated that current straightforward techniques for extrapolations to unknown nuclei are likely to fail if nuclear structure is not taken into account in a realistic way.

10549 (BNL—51778, pp 247-263) **Microscopic β and γ data for decay heat needs.** Dickens, J.K. (Oak Ridge National Lab., TN). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Microscopic β and γ data for decay heat needs are defined as absolute intensity spectral distributions of β and γ rays following radioactive decay of radionuclides created by, or following, the fission process. Four well-known evaluated data files, namely the US ENDF/B-V, the UK UKFPDD-2, the French BDN (for fission products), and the Japanese JNDC Nuclear Data Library, are reviewed. Comments regarding the analyses of experimental data (particularly γ-ray data) are given; the need for complete β-ray spectral measurements is emphasized. Suggestions on goals for near-term future experimental measurements are presented.

10550 (BNL—51778, pp 319-320) **Determination of the strengths of some first forbidden β-transitions.** Fogelberg, B.; Kerek, A. (Studsvik Science Research Lab., Nykoeping, Sweden). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

In the present work the decays of ^{127} ^{129} ^{131}In, ^{133}Sn and ^{135}Te have been studied at the OSIRIS mass separator facility, yielding log ft values for 13 β-transitions between five different pairs of shell model states. The resulting log ft values are given in a table together with data for first forbidden transitions in the decays of ^{133}In and ^{134}Sb. The fact that five of the 17 β-transitions in the table have log ft values which are smaller than, or equal to, the average of log ft = 5.5 observed for allowed transitions suggests that first forbidden β-strength can be quite significant over a large region of the heavy fission product mass peak.

10551 (BNL—51778, pp 337-364) **Survey of delayed neutron emission probabilities.** Reeder, P.L. (Pacific Northwest Lab., Richland, WA). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—). Contract AC06-76RL01830.

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

This paper summarizes the techniques used to measure the delayed neutron emission probability and includes an evaluated list of all experimental values for fission product precursors. Various models and theories for calculating these probabilities are summarized. The application of estimated and experimental delayed neutron emission probabilities to the calculation of delayed neutron yields from fission is illustrated. Some suggestions for new and improved measurements are presented. Emission probabilities for non-fission product precursors are compiled in a separate table. The recently discovered processes of β-delayed two-neutron and β-delayed three-neutron emission are reviewed.

10552 (BNL—51778, pp 449-453) **Neutron resonances in nuclides far from stability via energy spectra of β-delayed neutrons.** Clark, D.D.; McElroy, R.D.; Yeh, T.R.; Chrien, R.E.; Gill, R.L. (Cornell Univ., Ithaca, NY). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Recent results are reported on high-resolution neutron energy spectra below 100 keV for the precursors ^{96}Rb and ^{97}Rb taken with an improved time-of-flight system at the TRISTAN separator. A preliminary value of 300 +/- 40 eV is deduced for the natural width of the 14-keV resonance in ^{96}Rb. The long term goals of the program are discussed.

10553 (BNL—51778, pp 455-457) **β-delayed neutron spectra from $^{93-97}$Rb and $^{145-146}$Cs.** Clark, D.D.; Yeh, T.R.; Lee, C.H.; Yuan, L.J.; Shmid, M.; Gill, R.L.; Chrien, R.E. (Cornell Univ., Ithaca, NY). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

As part of a program of studies of delayed-neutron emission using the TRISTAN facility at Brookhaven National Laboratory, spectra of delayed neutrons from the separated precursors $^{93-97}$Rb and $^{145-146}$Cs have been measured. A ^{3}He neutron spectrometer of the Cuttler-Shalev type with a FWHM of 13 keV for thermal neutrons was used. The spectra and average energies are very similar to those previously obtained elsewhere. A simplified statistical model was used to attempt fits to the spectra and to the partial neutron emission probabilities p/sub n//sup i/ obtained elsewhere but only moderately good agreement was possible.

10554 (BNL—51778, pp 321-329) **Symmetric deformation in A approximately 100 odd and odd-odd nuclei and its influence on fission product β-decay rates.** Meyer, R.A.; Kaffrell, N.; Lawin, H.; Lhersonneau, G.; Monnard, E.; Paar, V.; Pfeiffer, B.; Pinston, J.A.; Ragnarsson, I.; Schussler, F. (IKP KFA-Juelich GmbH, West Germany). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—). Contract W-7405-ENG-48.

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Nuclear shape changes can bring about rapid changes in nuclear properties. That such vibrational → symmetric rotor → asymmetric nucleus changes may be present in the A approximately 100 region is suggested by rapid, low-energy level density changes and unexpected β-decay rate changes in several series of odd-odd and odd-mass fisions product nuclei. In order to define the nature of these nuclei we have performed measurements on a series of nuclei using JOSEF and Lohengrin mass separators, fast-chemistry, and n-capture γ-ray techniques. Here we summarize the several features we find.

10555 **Fission cross sections up to 20 MeV/nucleon.** Gavron, A.; Boissevain, J.; Britt, H.C.; Eskola, K.; Eskola, P.; Fowler, M.M.; Ohm, H.; Wilhelmy, J.B.; Awes, T.C.; Ferguson, R.L. . (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* 30: No. 5, 1550-1560(Nov 1984).

Fission cross sections have been measured for the following reactions: ^{12}C(at E/sub b/ = 95, 122, 186, 245, and 291 MeV) on ^{174}Yb, ^{198}Pt, and ^{238}U; ^{16}O (at E/sub b/ = 140, 175, 216, 250, and 315 MeV) on ^{142}Nd, ^{170}Er, ^{192}Os, and ^{238}U; ^{32}S (at E/sub b/ = 350, 500, and 700 MeV) on ^{126}Te, ^{144}Nd, and ^{238}U; and ^{58}Ni (at E/sub b/ = 352 and 875 MeV) on ^{96}Zr, ^{116}Cd, and ^{238}U. We find

that use of statistical model calculations with the Bass heavy-ion potential, which fit the data below 10 MeV/nucleon, do not fit fission cross sections at higher energies. Invoking dynamical limitations to fusion such as "extra-push" model calculations improves the fit to most of the data. For ^{12}C and ^{16}O projectiles on lighter targets, the fission cross section at higher energies is significantly below the value obtained from the rotating liquid drop angular momentum limit, indicating that incomplete fusion reactions may be limiting the fusion process. For S and Ni projectiles, the cross section implies the existence of a composite system sustaining angular momenta far above the limit beyond which, on the basis of liquid drop model predictions, compound nuclei are not expected to have a finite fission barrier. The angular distribution of fission fragments in ^{12}C- and ^{16}O-induced reactions has been measured and compared to calculated values. Discrepancies between the measurements and calculated values infer conditions for the breakdown of the transition state model.

10556 **Dynamics of incomplete fusion reactions from γ-ray circular-polarization measurements.** Trautmann, W.; Hansen, O.; Tricoire, H.; Hering, W.; Ritzka, R.; Trombik, W. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **53**: No. 17, 1630-1633(22 Oct 1984). Contract AC02-76CH00016.

The circular polarization P/sub γ/ of deexcitation γ rays has been measured in coincidence with fast charged particles from reactions induced by light heavy ions at E/Aroughly-equal8 MeV. Polarizations of up to 'P/sub γ/'roughly-equal0.3 were observed. The variations of P/sub γ/ in sign and magnitude with the particle type, energy, and angle, and with the target mass reveal the effects of the particle-target interaction during a tangential passage along the target nucleus.

10557 **Nuclear data sheets for A = 148.** Peker, L.K. (National Nuclear Data Center, Brookhaven National Laboratory, Upton, New York 11973, USA). *Nuclear Data Sheets;* **42**: No. 2, 111-231(Jun 1984).

The experimental nuclear structure data available through June 1983 have been reviewed. A summary of information obtained in various reaction and decay experiments is presented, together with adopted level schemes.

6518 Nuclear Properties And Reactions, A=150-189

10558 **(CONF-8403127—5) Competition between rotational and aligned-particle high-spin excitations in ^{153} ^{154}Dy .** Pakkanen, A.; Kortelahti, M.; Broda, R.; Chung, Y.H.; Daly, P.J.; Faber, S.R.; Grabowski, Z.; Helppi, H.; McNeill, J.; Khoo, T.L. (Purdue Univ., Lafayette, IN (USA); Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004068.

From 5. Nordic meeting on nuclear physics; Jyvaskyla, Finland (12 Mar 1984).

High-spin level structure of the transitional N = 87,88 ^{153} ^{154}Dy nuclei have been studied using ^{124}Sn(^{34}S,xn) reactions. In both nuclei the lower part of the level scheme includes decoupled rotational bands indicating prolate deformation in yrast structures between I = 17/2 and 41/2 in ^{153}Dy and up to I = 30 in ^{154}Dy. Above these collective bands the level structure becomes irregular, very similar to the aligned multiparticle structure in ^{152}Dy. The yrast 2.3 ns 47/2 isomer at 5591 keV shows that aligned-particle excitations compete successfully with collective rotation above 5 MeV in ^{153}Dy. The similar change occurs in ^{154}Dy above 10 MeV after the S-band has crossed with the S'-band. The aligned configurations are connected with the oblate shape of the nucleus and our results show that a transition from a basically prolate to oblate shape occurs in ^{153}Dy above I = 41/2 and in ^{154}Dy above I = 32.

10559 **Evidence from α decay that Z = 82 is not magic for light Pb isotopes.** Toth, K.S.; Ellis-Akovali, Y.A.; Bingham, C.R.; Moltz, D.M.; Sousa, D.C.; Carter, H.K.; Mlekodaj, R.L.; Spejewski, E.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **53**: No. 17, 1623-1626(22 Oct 1984). Contract AC05-76OR00033;AS05-76ER04936.

To resolve the reported anomalous behavior of the α-decay rates of /sup 186,188,190,192/Pb we determined more accurate α-decay branches for these isotopes. Our data result in α-decay reduced widths whose dependence on N is similar to that observed for other elements. However, contrary to the expectation of a shell effect at Z = 82, this new information indicates lead nuclei to be less hindered toward α decay than mercury isotopes. It appears that midway between n = 82 and N = 126 the proton number of 82 is not magic.

10560 **Measurement and analysis of muonic x rays of 176,177,178,179,180Hf.** Tanaka, Y.; Steffen, R.M.; Shera, E.B.; Reuter, W.; Hoehn, M.V.; Zumbro, J.D. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 350-359(Jul 1984).

Monopole and quadrupole charge distributions of ^{176}Hf, ^{177}Hf, ^{178}Hf, ^{179}Hf, and ^{180}Hf were investigated by muonic atom K and L x-ray measurements. The model-independent Barrett charge radii R/sub k/ and the isotope shifts ΔR/sub k/ were measured, and values of $<r^2>$ and $\Delta<r^2>$ were deduced. A weak odd-even staggering of the nuclear charge radii was observed for the series $^{176-178}$Hf and $^{178-180}$Hf. A large negative isomer shift was observed in the 2^+ state of the ^{176}Hf nucleus, a fact that existing theories do not explain. The quadrupole moments of the first excited states of the hafnium nuclei were determined to be $Q^{176}(2^+) = -2.10(2)$ e b, $Q^{177}((9/2)^-) = 1.30(2)$ e b, $Q^{178}(2^+) = -2.02(2)$ e b, $Q^{179}((11/2)^+) = 1.88(3)$ e b, and $Q^{180}(2^+) = -2.00(2)$ e b. These quadrupole moments and the simultaneously determined B(E2) values for the respective nuclei are in satisfactory agreement with the predictions of the axially symmetric rotor model.

6519 Nuclear Properties And Reactions, A=190-219

10561 **(BNL-NCS—35514) Total and spontaneous fission half-lives of the uranium and plutonium nuclides.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 7p. (CONF-8411118—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004703.

From Meeting on nuclear standard reference data; Geel, Belgium (12 Nov 1984).

The total half-life and the half-life for spontaneous fission are evaluated for the various long-lived nuclides of interest. Recommended values are presented for ^{232}U, ^{233}U, ^{234}U, ^{235}U, ^{236}U, ^{238}U, ^{236}Pu, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, and ^{244}Pu. The uncertainties are provided at the 95% confidence limit for each of the recommended values.

10562 **Enhanced emission of nonequilibrium light particles in the reaction plane.** Tsang, M.B.; Chitwood, C.B.; Fields, D.J.; Gelbke, C.K.; Klesch, D.R.; Lynch, W.G.; Kwiatkowski, K.; Viola, V.E. Jr. (Department of Physics and National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). *Physical Review Letters;* **52**: No. 22, 1967-1970(28 May 1984). Contract AC02-81ER40007.

Nonequilibrium light particles were detected in coincidence with two fission fragments for ^{14}N-induced reactions on ^{197}Au at 420 MeV incident energy. Coincident binary-fission events were used to define the reaction plane and to suppress contributions from transferlike peripheral reactions. A strong preference for the emission of nonequilibrium light particles in the fission plane was observed, suggesting the presence of an ordered transverse motion of the emitting source in the reaction plane.

10563 **Semiclassical model used for elastic and inelastic scattering of heavy ion.** Chenglie, J.; Christensen, P.R.; Hansen, O.; Pontoppidan, S.; Videbaek, F.; Bond, P.D. (Institute of Atomic Energy, Beijing, People's Republic of China). *Zhonghua Heyixue Zazhi;* **5**: No. 2, 150-156(May 1983). (In Chinese).

In collisions of very heavy ions with nuclei, there is a significant feature, that the Coulomb couplings between the elastic and inelastic scattering channels are often rather strong. A simple semi-

classical model is suggested in order to describe the elastic and inelastic scattering of heavy ion collisions, which assumes the Coulomb excitation and the nuclear interaction are two nearly independent processes. The experimental results can be reproduced by this simple model. The calculated results of this model are compared with the coupled channel calculations and the optical model calculations which includes a long range polarization potential. It is suggested the standard optical model should be used in the description of the total of the elastic scattering and those inelastic scattering groups which have strong Coulomb couplings with elastic scattering channel.

6520 Nuclear Properties And Reactions, A=220 And Above

REFER ALSO TO CITATION(S) 65201010532, 10546, 10547, 10551, 10574, 10577

10564 (BNL—51778, pp 65-90) **Systematics of neutron-induced fission yields.** Blachot, J.; Brissot, R. (Centre d'Etudes Nucleaires, Grenoble, France). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

The main characteristics of the mass and charge distributions for thermal neutron-induced fission of actinides are reviewed. It is shown that these distributions can be reasonably reproduced with only ≈24 data as input. A representation where the element yields together with the most probable mass A/sub p/(Z) play the dominant role is used. The ability of this model to calculate mass yields for the fission of not yet measured actinides is also shown. The influence of the excitation energy of the fissile system on charge and mass distribution is also discussed.

10565 (BNL—51778, pp 313-318) **Decay heat calculation with the C.E.A. radioactivity data bank.** Duchemin, B.; Blachot, J.; Nimal, B.; Nimal, J.C.; Veillaut, J.P. (Commissariat a l'Energie Atomique, Saclay, France). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

For a long time the French CEA has developed a radioactivity data bank. This bank is updated using ENSDF and some recent experimental results. The fission product part of this library is currently used for shielding source and decay heat calculations. A computer code called PEPIN, using direct summation method has been developed and is briefly described. A comparison is made with other calculations and available experiments.

10566 (BNL—51778, pp 423-447) **Prompt fission neutron spectra and average prompt neutron multiplicities.** Madland, D.G.; Nix, J.R. (Los Alamos National Lab., NM). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

A new method is presented for calculating the prompt fission neutron spectrum N(E) and average prompt neutron multiplicity anti nu/sub p/ as functions of the fissioning nucleus and its excitation energy. The method is based on standard nuclear evaporation theory and takes into account (1) the motion of the fission fragments, (2) the distribution of fission-fragment residual nuclear temperature, (3) the energy dependence of the cross section σ/sub c/ for the inverse process of compound-nucleus formation, and (4) the possibility of multiple-chance fission. A triangular distribution in residual nuclear temperature based on the Fermi-gas model is used. This leads to closed expressions for N(E) and anti nu/sub p/ when anti σ/sub c/ is assumed constant and readily computed quadratures when the energy dependence of σ/sub c/ is determined from an optical model. Neutron spectra and average multiplicities calculated with an energy-dependent cross section agree well with experimental data for the neutron-induced fission of ^{235}U and the spontaneous fission of ^{252}Cf. For the latter case, there are some significant inconsistencies between the experimental spectra that need to be resolved.

10567 (BNL—51778, pp 7-32) **Independent fission yield measurements.** Denschlag, H.O. (Universitaet, Mainz, West Germany). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Various methods to measure independent yields are reviewed and discussed. A survey and actual measurements carried out after 1978 is given.

10568 (BNL—51778, pp 33-64) **Status of fission yield evaluations.** England, T.R.; Rider, B.F. (Los Alamos National Lab., NM). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Very few yield compilations are also evaluations, and very few contain an extensive global library of measured data and extensive models for unmeasured data. The earlier UK evaluations and US evaluations were comparable up to the retirements of the primary evaluators. Only the effort in the US has been continued and expanded. The previous UK evaluations have been published. In this paper the current status of the US evaluation, philosophy, and various integral yield tests for 34 fissioning nuclides at one or more neutron incident energies and/or for spontaneous fission are summarized. Currently there are 50 yield sets and for each there are independent and cumulative yields and uncertainties for approximately 1100 fission products. When finalized, the recommended data will become part of the next version of the US Evaluated Nuclear Data File (ENDF/B-VI). The complete set of data, including the basic input of measured yields, will be issued as a sequel to the General Electric evaluation reports (better known by the authors' names: Rider--or earlier--Meek and Rider.

10569 (BNL—51778, pp 91-120) **Determination and correlation of fast reactor fission yields with neutron energy.** Maeck, W.J. (Exxon Nuclear Idaho Co., Idaho Falls). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

The correlation of fast reactor fission yields for ^{235}U and ^{239}Pu with neutron energy is reviewed and updated. The primary data base for this study was mass spectrometric values for both the relative isotopic composition and the absolute fission yields of the major fission products. The neutron energy index used in the correlation study was the isotope ratio of ^{150}Nd/^{143}Nd. The correlation of the isotopic abundance and fission yields of the major fission products is linear with this ratio over a wide energy range. Good correlation of the ^{235}U fast fission yields with neutron energy is shown. For ^{239}Pu, the correlations show more scatter and the need for additional ^{239}Pu fast fission yield data is stressed. As part of this review, the current ENDF/B-V yield values, both thermal and fast, were compared to the results given in this paper. Several discrepancies between the ENDF/B-V values and those obtained in this review process are identified. Reevaluation of several ^{239}Pu thermal and fast yields is indicated. This effort of correlating fast yields with energy must be continued and the energy dependency factor considered if the compiled yields and associated uncertainties are to be meaningful.

10570 (BNL—51778, pp 121-132) **Fission yield data for neutron dosimetry.** Fudge, A.J. (United Kingdom Atomic Energy Authority, Harwell, England). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Fissionable nuclides now form a very important part of the measurement of neutron fluence associated with material damage studies and reactor pressure vessel safety assessments. ^{237}Np, ^{238}U, and ^{232}Th, which undergo fission only by interaction with neutrons above a threshold energy, are routinely used both for surveillance monitoring of integrated damage dose and for neutron spectrum evaluation by multiple foil analysis. The fission yield values and their uncertainties relate directly to the absolute level and uncer-

tainties of the damage dose estimates. Fission yields of these nuclides are obtained from individual experiments, bench-mark interlaboratory comparisons, and evaluations of all measured data. The present status of these yield values and their uncertainties is discussed and recommendations made for resolving discrepancies.

10571 (BNL—51778, pp 133-136) **Shielded mass 136 yield from fast fission of ^{235}U, ^{235}U, ^{237}Np, ^{239}Pu, and ^{242}Pu.** Chapman, T.C.; Tromp, R.L.; Emel, W.A. (Exxon Nuclear Idaho Company, Inc., Idaho Falls). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—). Contract AC07-79ID01675.

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Fast fission yields for the shielded portion of the 136 mass chain from fast fission of ^{233}U, ^{235}U, ^{237}Np ^{239}Pu, ^{240}Pu, ^{241}Pu and ^{242}Pu were determined subsequent to capsule irradiation in Row 8 of the Experimental Breeder Reactor II (EBR-II). The measurement technique used was isotope dilution mass spectrometry. For the first time precise (<9%) shielded mass 136 yields for fast fission of ^{237}Np, ^{240}Pu, ^{241}Pu and ^{242}Pu are available.

10572 (BNL—51778, pp 137-152) **γ branching ratios for fission products: application to the study of the yield distribution from ^{235}U (thermal neutrons, fission).** Lund, E.; Rudstam, G.; Aagaard, P.; Zwicky, H.U. (Studsvik Science Research Lab., Nykoeping, Sweden). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

This poster outlines the determination of γ-branching ratios and its application to the study of the yield distribution of products from thermal-neutron induced fission of ^{235}U. The yield study covers 133 fission products including 36 isomeric states. For most of them γ-branching ratios have been determined to be used in the analysis. Final results are presented for isotopes of bromine, krypton, and rubidium.

10573 (BNL—51778, pp 153-156) **Uncertainties on the pseudo fission product for fast power reactors due to the yields library.** Rimpault, G.; Martin-Deidier, L. (CEA-Cen/Cadarache, St. Paul Lez Durance, France). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

The aim of this report is to evaluate an uncertainty on the pseudo fission product due to uncertainties on yields. Due to the lack of specific indications in present compilations on yield uncertainty correlation an analytical approach has been made. The calculation gives a 6% estimated uncertainty on the pseudo fission product cross-sections and a 150 pcm uncertainty on reactivity for the equilibrium cycle in SUPER PHENIX.

10574 (BNL—51778, pp 227-247) **Problems in decay heat measurement and evaluation.** James, M.F. (UKAEA Atomic Energy Establishment, Winfrith, England). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Methods of comparing decay heat measurements are discussed, and the results illustrated. A number of libraries of fission product decay data and yields are now available, and calculations with them are compared with each other and with measurements. There are clearly significant discrepancies which have yet to be resolved; some comments on possible solutions are indicated. The need to consider all available theoretical and experimental data in any future library evaluation is emphasized.

10575 (BNL—51778, pp 305-312) **γ decay heat for 14 MeV neutron fissions of ^{235}U, ^{238}U and ^{232}Th.** Akiyama, M.; An, S. (Univ. of Tokyo, Japan). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Fission-product decay γ energy release rates have been measured for 14 MeV neutron fissions of ^{235}U, ^{238}U and ^{232}Th. Samples were irradiated for time periods of 1000 seconds (^{235}U), 60 and 300 seconds (^{238}U and ^{232}Th) by 14 MeV neutrons produced by DT reactions. Spectral data for γ-ray were obtained using a NaI(Tl) scintillation spectrometer. The γ energy release rates were derived by integrating the experimental spectral data normalized to unit number of fissions. These results were compared with the results of decay heat for fast fissions and summation calculations.

10576 (BNL—51778, pp 459-468) **Delayed neutron spectrum measurements and covariance analysis.** Weaver, D.R.; Owen, J.G.; Walker, J. (Univ. of Birmingham, England). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Improvements have been made in the electronics employed with two ^{3}He neutron spectrometers; these changes allow greater neutron source fluxes to be used in delayed neutron spectrum measurements. Measurements of the delayed neutrons emitted following fission induced in ^{235}U by neutrons from the Be(d,n) reaction are reported. Covariance matrix analysis has been applied to proton recoil spectrometer results from the University of Washington.

10577 (BNL—51778, pp 469-484) **Atomic masses of fission product nuclei far from stability.** Brenner, D.S. (Clark Univ., Worcester, MA). 1983. NTIS, PC A24/MF A01. File Number DE85000967. (CONF-8310104—).

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

The techniques for measuring fission product masses far from stability are discussed and recent progress in experimental measurements is reviewed. A comparison of new mass values with predictions of 10 mass equations suggests that most theories predict far-from-stability fission product nuclei to be more bound than is found experimentally. A closer look at several isotopic chains is used to identify regions of structural change where mass equations encounter difficulty.

10578 (BNL-NCS—35513) **Reevaluation of the average prompt neutron emission multiplicity (nubar) values from fission of uranium and transuranium nuclides.** Holden, N.E.; Zucker, M.S. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 14p. (CONF-8411118—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE85005130.

From Meeting on nuclear standard reference data; Geel, Belgium (12 Nov 1984).

In response to a need of the safeguards community, we have begun an evaluation effort to upgrade the recommended values of the prompt neutron emission multiplicity distribution, P/sub nu/ and its average value, nubar. This paper will report on progress achieved thus far. The evaluation of the uranium, plutonium, americium and curium nuclide's nubar values will be presented. The recommended values will be given and discussed. 61 references.

10579 (BNL-NCS—35521) **Total and spontaneous fission half-lives of the americium and curium nuclides.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 4p. (CONF-8411118—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004911.

From Meeting on nuclear standard reference data; Geel, Belgium (12 Nov 1984).

The total half-life and the half-life for spontaneous fission are evaluated for the various long-lived nuclides of interest. Recommended values are presented for ^{241}Am, /sup 242m/Am, ^{243}Am, ^{242}Cm, ^{243}Cm, ^{244}Cm, ^{245}Cm, ^{246}Cm, ^{247}Cm, ^{248}Cm, and ^{250}Cm. The uncertainties are provided at the 95% confidence limit for each of the recommended values.

10580 (LA-UR—84-3557) Differential and integral comparisons of three representations of the prompt neutron spectrum for the spontaneous fission of ^{252}Cf. Madland, D.G.; LaBauve, R.J.; Nix, J.R. (Los Alamos National Lab., NM (USA)). 1 Nov 1984. Contract W-7405-ENG-36. 28p. (CONF-8411118—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85003728.

From Meeting on nuclear standard reference data; Geel, Belgium (12 Nov 1984).

Because of their importance as neutron standards, we present comparisons of measured and calculated prompt fission neutron spectra N(E) and average prompt neutron multiplicities anti nu/sub p/ for the spontaneous fission of ^{252}Cf. In particular, we test three representations of N(E) against recent experimental measurements of the differential spectrum and threshold integral cross sections. These representations are the Maxwellian spectrum, the NBS spectrum, and the Los Alamos spectrum of Madland and Nix. For the Maxwellian spectrum, we obtain the value of the Maxwellian temperature T/sub M/ by a least-squares adjustment to the experimental differential spectrum of Poenitz and Tamura. For the Los Alamos spectrum, a similar least-squares adjustment determines the nuclear level-density parameter a, which is the single unknown parameter that appears. The NBS spectrum has been previously constructed by adjustments to eight differential spectra measured during the period 1965 to 1974. Among these three representations, we find that the Los Alamos spectrum best reproduces both the differential and integral measurements, assuming ENDF/B-V cross sections in the calculation of the latter. Although the NBS spectrum reproduces the integral measurements fairly well, it fails to satisfactorily reproduce the new differential measurement, and the Maxwellian spectrum fails to satisfactorily reproduce the integral measurements. Additionally, we calculate a value of anti nu/sub p/ from the Los Alamos theory that is within approximately 1% of experiment. 25 references.

10581 Level structure and deexcitations in ^{220}Ra and their systematic behavior as a function of neutron number. Cottle, P.D.; Shriner, J.F. Jr.; Dellagiacoma, F.; Ennis, J.F.; Gai, M.; Bromley, D.A.; Olness, J.W.; Warburton, E.K.; Hildingsson, L.; Quader, M.A. (A.W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 5, 1768-1771(Nov 1984). Contract AC02-76ER03074;AC02-76CH00016.

The level scheme of ^{220}Ra, constructed from ^{208}Pb(^{14}C,2nγ)^{220}Ra data, shows structure similar to that of ^{218}Ra, with interleaved states of alternating parities connected by enhanced B(E1) deexcitations. The B(E1)/B(E2) ratios (for moderately high spins) are two to three times smaller than in ^{218}Ra; we observe a smooth and rapid increase of the B(E1) values toward shell closures. The systematics of the Ra isotopes are used to examine the alpha cluster model of Iachello-Jackson and the permanent octupole shape model.

10582 Independent yields of the isomers of ^{133}Xe and ^{135}Xe for neutron-induced fission of ^{233}U, ^{235}U, ^{238}U, ^{239}Pu, and ^{242}Am/sup m/. Ford, G.P.; Wolfsberg, K.; Erdal, B.R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 195-213(Jul 1984).

Fractional independent yields of ^{133}Xe/sup m/, ^{133}Xe /sup g/, ^{135}Xe/sup m/, and ^{135}Xe /sup g/ have been measured for fission of ^{233}U, ^{235}U, ^{239}Pu, and ^{242}Am/sup m/ induced by thermal neutrons and for fission of ^{235}U, ^{238}U, and ^{239}Pu induced by 14-MeV neutrons. The same yields have been measured for fission of ^{235}U induced by degraded fission spectrum neutrons from a bare critical assembly. Some upper limits and ratios of yields of these same isomers have been obtained for the fission of ^{238}U and ^{239}Pu by the degraded fission spectrum neutrons. The average angular momentum of these independently formed fission products has been derived from the measured isomer ratios. A method that is particularly well adapted to use with computers for solving the differential equations of radioactive decay and growth is described.

10583 Nuclear data sheets for A = 231, 235, 239. Schmorak, M.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830, USA). *Nuclear Data Sheets;* **40**: No. 1, 1-147(Sep 1983). Contract AC05-84OR21400.

Experimental data pertaining to nuclear structure of nuclei with mass numbers A = 231, 235, and 239 have been compiled and evaluated.

6530 Nuclear Theory

10584 (DOE/ER/05126—183) Interacting boson approximation. Rosen, S.P. (National Science Foundation, Washington, DC (USA). Div. of Physics; Purdue Univ., Lafayette, IN (USA)). 1984. Contract AS05-76ER05126. 49p. (ORO—5126-183). NTIS, PC A03/MF A01; GPO Dep. File Number DE85003016.

Lecture Series No. 4 in Theoretical Nuclear Physics.

Lectures notes on the Interacting Boson Approximation are given. Topics include: angular momentum tensors; properties of T/sub i//sup (n)/ matrices; T/sub i//sup (n)/ matrices as Clebsch-Gordan coefficients; construction of higher rank tensors; normalization: trace of products of two s-rank tensors; completeness relation; algebra of U(N); eigenvalue of the quadratic Casimir operator for U(3); general result for U(N); angular momentum content of U(3) representation; p-Boson model; Hamiltonian; quadrupole transitions; S,P Boson model; expectation value of dipole operator; S-D model: U(6); quadratic Casimir operator; an O(5) subgroup; an O(6) subgroup; properties of O(5) representations; quadratic Casimir operator; quadratic Casimir operator for U(6); decomposition via SU(5) chain; a special O(3) decomposition of SU(3); useful identities; a useful property of D/sub $\alpha\beta\gamma$/(α,β,γ = 4-8) as coupling coefficients; explicit construction of T/sub x//sup (2)/ and d/sub $\alpha\beta\gamma$/; D-coefficients; eigenstates of T_3; and summary of T = 2 states. (WHK)

10585 (LA-UR—84-3470) Constructive approach to the ground-state energy of a hard-core square-well fermion system. Baker, G.A. Jr. (Los Alamos National Lab., NM (USA); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Sep 1984. Contract W-7405-ENG-36. 4p. (CONF-8409187—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003746.

From 8. international workshop on condensed matter theories; Granada, Spain (17 Sep 1984).

I am looking at the old problem of the ground-state energy of quantum many-Fermion systems. My tools will be a version of perturbation theory. It is plain that the ordinary, low-density rearrangement can not be used directly to compute the saturation energy and density of a system for which the two-body potential has a strong repulsive core and an attractive portion beyond the core, because the path of continuation from low-density to saturation density passes through the two-phase (vacuum, liquid) region. Likewise it is difficult to supply an expansion directly in λ for fixed rho (density) because of the difficulty of the strong repulsive core and the tediousness of the calculations. My approach here is to expand the energy in a double series in k/sub F/, the Fermi momentum, and λ, the strength of the attractive part of the potential. The plan is then to sum up, by the Pade method or a generalization of it, the k/sub F/ expansions of the coefficients of each power of λ into a function of k/sub F/. The coefficient of λ^0 is just the repulsive-core energy itself.

10586 Angular velocity: a new dimension in nuclei. Diamond, R.M.; Stephens, F.S. (Lawrence Berkeley Lab., CA). *Nature (London);* **310**: No. 5977, 457-463(9 Aug 1984).

Nuclei can be studied from their ground states (approx.O(h/2π)) up to angular momenta of order 100 (h/2π), where they are literally pulled apart by centrifugal effects. This range of angular momenta can be viewed as resulting from cranking the nucleus around a rotation axis, where the critical variable is the cranking velocity. The calculated response of nuclei to such an imposed angular velocity corresponds well with recent observations, and includes a rich and varied interplay of collective and single-particle phenomena.

10587 Role of finite boson number and axial asymmetry in IBA-1; evidence for multi-J supersymmetries in odd nuclei. Casten, R.F. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Physics [Section] A:* **421**: 27-42(11 Jun 1984). (CONF-8309205—). Contract AC02-76CH00016.

From Workshop on collective states in nuclei; Taiwan, China (8 Sep 1983).

In Part I, the consistent Q formalism of the IBA is outlined and a number of characteristic and systematic predictions compared with data from deformed and transitional nuclei. The extreme simplicity of the formalism (with only one important parameter) is exploited to isolate particular features of the IBA such as the role of finite boson number effects. These are shown to be substantially more important than heretofore thought and for reasons that relate to the basic structure of the IBA and to the ways in which the limiting symmetries are broken in calculations for realistic nuclei. The consistent Q formalism is also utilized to establish that there is an effective, dynamical axial asymmetry even in IBA-1, and to derive a correlation between IBA-1 calculations and an effective asymmetry parameter, γ. The relation between this effective asymmetry, in which the classical potential minimum is still at $\gamma=0^0$, and true triaxial shapes arising from the introduction of cubic terms is discussed. In Part II, the question of supersymmetries in the IBA is addressed, with emphasis on realistic multi-j cases. The study of such schemes requires an experimental probe which can disclose all states of certain Jsup(π) values within a given excitation energy range. The non-selective (n,γ) reaction is such a tool and its principal features are outlined. The evidence for and against the validity of a supersymmetry scheme in the odd Pt isotopes is summarized, including a discussion of two alternate group chain decompositions. Finally, the wave functions for the lowest levels of these two chains are examined, both relative to each other and, via a simple transformation, in terms of a set of basis states corresponding to an odd j=1/2, 3/2 or 5/2 fermion coupled to O(6) core states.

10588 Nuclear moments of inertia at high spins. Deleplanque, M.A. (Lawrence Berkeley Lab., CA (USA)). *Nuclear Physics [Section] A;* **421**: 339-352(11 Jun 1984). (CONF-8309205—).

From Workshop on collective states in nuclei; Taiwan, China (8 Sep 1983).

Also published as report LBL--17082; CONF-8309205--1.

Nuclei with highest angular momentum are discussed. The production of high spin states, and the basic ideas associated with high spin physics are reviewed. Recent developments from 'continuum' γ-ray studies are presented: the measurement of different average moments of inertia gives new information on the interplay between collective and single particle aspects at high spins. Finally, the exciting possibility of resolving the 'continuum' spectra with new detector systems is examined.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 6540009855, 10203, 10745, 10746

10589 (HMI-B—411) Symposium on neutron scattering. Lehmann, M.S.; Saenger, W.; Hildebrandt, G.; Dachs, H. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). 1984. 274p. (CONF-840874—). Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.).

From Symposium on neutron scattering; Berlin, F.R. Germany (9 Aug 1984).

Extended abstracts of the named symposium are presented. The first part of this report contains the abstracts of the lectures, the second those of the posters. Topics discussed on the symposium include neutron diffraction and neutron scattering studies in magnetism, solid state chemistry and physics, materials research. Some papers discussing instruments and methods are included too.

10590 (LA—10258-M) User's guide for TWOHEX: a code package for two-dimensional, neutral-particle transport in equilateral triangular meshes. Walters, W.F.; Brinkley, F.W.; Marr, D.R. (Los Alamos National Lab., NM (USA)). Oct 1984. Contract W-7405-ENG-36. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004482.

TWOHEX solves the two-dimensional multigroup transport equation on an equilateral triangular mesh in the x,y plane. Both regular and adjoint, inhomogeneous (fixed source) and homogeneous problems are solved. Three problem domains are treated by TWOHEX. The whole core domain is a 60^0 parallelogram with vacuum boundary conditions on each face. The third core domain is a 120^0 parallelogram with two vacuum and two rotational boundary conditions. The sixth core domain is a 60^0 parallelogram with two vacuum and two rotational boundary conditions. General anisotropic scattering is allowed and an anisotropic inhomogeneous source may be input as cell averages.

10591 (UCRL—91043-Rev.1) Channeling-radiation measurements at Lawrence Livermore National Laboratory. Revision 1. Berman, B.L.; Dahling, B.A.; Datz, S.; Kephart, J.O.; Klein, R.K.; Pantell, R.H.; Park, H. (Lawrence Livermore National Lab., CA (USA); Oak Ridge National Lab., TN (USA); Stanford Univ., CA (USA). Dept. of Electrical Engineering). Oct 1984. Contract W-7405-ENG-48. 25p. (CONF-841117—8-Rev.1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004991.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

In the last few years, the amount and quality of channeling-radiation data have increased enormously, owing largely to much improved experimental capabilities. Current results included improved interplanar potentials for diamond, the description of the effect of platelets in diamond as an average thermal vibration, an improved determination of the Debye temperature of silicon, an improved determination of the thermal-vibration amplitude of LiD, and the demonstration that LiF crystal structures can survive intense electron bombardment. 40 references, 8 figures.

6550 Medical Physics

REFER ALSO TO CITATION(S) 6550009630, 9631, 9969

10592 (RHO-HS-ST—5P) Seven health physics calculator programs for the HP-41CV. Rittmann, P.D. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Aug 1984. Contract AC06-77RL01030. 88p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004010.

Several user-oriented programs for the Hewlett-Packard HP-41CV are explained. The first program builds, stores, alters, and ages a list of radionuclides. This program only handles single- and double-decay chains. The second program performs convenient conversions for the six nuclides of concern in plutonium handling. The conversions are between mass, activity, and weight percents of the isotopes. The source can be aged and/or neutron generation rates can be computed. The third program is a timekeeping program that improves the process of manually estimating and tracking personnel exposure during high dose rate tasks by replacing the pencil, paper, and stopwatch method. This program requires a time module. The remaining four programs deal with computations of time-integrated air concentrations at various distances from an airborne release. Building wake effects, source depletion by ground deposition, and sector averaging can all be included in the final printout of the X/Q - Hanford and X/Q - Pasquill programs. The shorter versions of these, H/Q and P/Q, compute centerline or sector-averaged values and include a subroutine to facilitate dose estimation by entering dose factors and quantities released. The horizontal and vertical dispersion parameters in the Pasquill-Gifford programs were modeled with simple, two-parameter functions that agreed very well with the usual textbook graphs. 8 references, 7 appendices.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 65600010063

10593 (LBL—17914) Chaotic dynamics of instabilities in solids. Jeffries, C.D. (Lawrence Berkeley Lab., CA (USA)). May 1984. Contract AC03-76SF00098. 78p. (CONF-8406186—2). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004909.

From 59. Nobel symposium - the physics of chaos and related phenomena; Graeftavallen, Sweden (11 Jun 1984).

A review is given of studies of chaotic dynamics in several solid state systems. In each case the physical system is described, relevant equations of motion are given, experimental results are presented and interpreted, more or less, from the relevant equations, including numerical solutions. The systems are: (1) An electron-hole helical plasma density wave in a Ge crystal in parallel electric and magnetic fields; this shows period doubling and quasiperiodic routes to chaos. (2) Standing mode spin wave packets in ferrite spheres, excited by driving ferromagnetic resonance of the uniform mode; this system shows period doubling to chaos and periodic windows. (3) Resonantly driven p-n junctions in Si show extremely nonlinear behavior due to charge stored during injection; one junction shows period doubling to chaos and period adding (frequency locking); coupled junctions show, in addition, quasi-periodicity, entrainment, and behavior generic to coupled nonlinear oscillator. The fractal dimension is measured for these systems. 44 references, 32 figures.

10594 (N—84-25464) Dense Coulomb plasmas: quantum statistics and ordering. Ashcroft, N.W.; Oliva, J. (Cornell Univ., Ithaca, NY (USA)). 1983. 4p. NTIS, PC A02/MF A01.

The low temperature equilibrium and transport properties of dense liquid metallic phases of hydrogen and deuterium are examined. Both systems can be regarded as dense Coulomb plasmas, but are considered in temperature ranges where the statistical differences are strikingly evident.

10595 (N—84-26407) Resistivity of a 2-D electron gas under strong magnetic field using a memory function formulation. Dacunhalima, I.C.; Ying, S.C. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). May 1984. 22p. (INPE—3118-PRE/513). NTIS, PC A02/MF A01.

A memory function projection operator technique is used to obtain the resistivity of a two dimensional electron gas under a strong magnetic field. In the dilute limit of impurities the resistivity is expressed in terms of an averaged force-force correlation function.

10596 (N—84-26408) Resistivity of a disordered 2-D electron gas in terms of force-force correlation function. Dacunhalima, I.C. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Apr 1984. 6p. (INPE—3065-PRE/482; CONF-8402101—1). NTIS, PC A02/MF A01.

From Simposio Latino-Am. de Fis. dos sistemas amorfos; Niteroi, Brazil (1 Feb 1984).

The lowest order diagram in a perturbative expansion of the force-force correlation function for a 2-D electron gas under strong magnetic field is used to calculate its resistivity.

10597 (N—84-26418) Memory function formalism applied to electronic transport in disordered systems. Dacunhalima, I.C. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Apr 1984. 14p. (INPE—3064-PRE/481; CONF-8402101—2). NTIS, PC A02/MF A01.

From Simposio Latino-Am. de Fis. dos sistemas amorfos; Niteroi, Brazil (1 Feb 1984).

Memory function formalism is briefly reviewed and applied to electronic transport using the projection operator technique. The resistivity of a disordered 2-D electron gas under strong magnetic field is obtained in terms of the force-force correlation function.

10598 (SAND—84-1373C) Vapor sensing by means of a ZnO-on-Si surface acoustic wave resonator. Martin, S.J.; Schweizer, K.S.; Schwartz, S.S.; Gunshor, R.L. (Sandia National Labs., Albuquerque, NM (USA); Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering). 1984. Contract AC04-76DP00789. 21p. (CONF-8411119—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003250.

From IEEE ultrasonics symposium; Dallas, TX, USA (14 Nov 1984).

Surface Acoustic Wave (SAW) devices can function as sensitive detectors of vapors. The high surface acoustic energy density of the device makes it extremely sensitive to the presence of molecules adsorbed from the gas phase. Mass loading by the adsorbate is the primary mechanism for the surface wave velocity perturbation. If the device is used as the frequency control element of an oscillator, perturbations in wave velocity on the order of 10 parts per billion may be resolved by means of a frequency counter. ZnO-on-Si SAW resonators have been examined as vapor sensors. The piezoelectric ZnO layer permits transduction between electrical and acoustic energies, as well as endowing the surface with particular adsorptive properties. These devices exhibit Q-values up to 12,000 at a resonant frequency of 109 MHZ. The resonant frequency of the device shifts upon exposure to a vapor-air mixture, with a transient response which is distinct for each of the organic vapors tested. Due to the permeability of the polycrystalline ZnO layer, the instantaneous reversibility of the resonant frequency shift is found to depend on the type of adsorbed molecule.

10599 (SAND—84-1464C) Peltier heat of a small polaron in a magnetic semiconductor. Liu, N.L.H.; Emin, D. (California Univ., Riverside (USA). Dept. of Physics; Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 17p. (CONF-841184—28). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000470.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

The heat transported with a small polaron in both antiferromagnetic and ferromagnetic semiconductors is calculated. This heat, the Peltier heat, π, is obtained from the change of the entropy of the total system upon introduction of a charge carrier. We explicitly consider both the intrasite and intersite exchange interactions between a small polaron and the interacting spins of a spin-1/2 magnet. There are two competing magnetic contributions to the Peltier heat. First, adding the carrier increases the spin entropy of the system. This provides a positive contribution to π. Second, the exchange between the carrier and the sites about it enhances the exchange binding between these sites. This reduces the energetically allowable spin configurations and provides a negative contribution to π. At extremely high temperature when kT exceeds the intrasite exchange energy, the first effect dominates. Then π is simply augmented by kTln2. However, well below the magnetic transition temperature the second effect dominates. In the experimentally accessible range between these limits both effects are comparable and sizable. The net magnetic contribution to the Peltier heat rises with temperature. Thus, a carrier's interactions with its magnetic environment produces a significant and distinctive contribution to its Peltier heat.

10600 Quasicrystals: A new class of ordered structures. Levine, D.; Steinhardt, P.J. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review Letters;* 53: No. 26, 2477-2480(24 Dec 1984).

A quasicrystal is the natural extension of the notion of a crystal to structures with quasiperiodic, rather than periodic, translational order. We classify two- and three-dimensional quasicrystals by their symmetry under rotation and show that many disallowed crystal symmetries are allowed quasicrystal symmetries. We analytically compute the diffraction pattern of an ideal quasicrystal and show that the recently observed electron diffraction pattern of an Al-Mn alloy is closely related to that of an icosahedral quasicrystal.

10601 **Recurrence relations and time evolution in the three-dimensional Sawada model.** Lee, M.H.; Hong, J. (Department of Physics, University of Georgia, Athens, Georgia 30602). *Physical Review [Section] B: Condensed Matter;* **30**: No. 11, 6756-6758(1 Dec 1984). Contract AS09-77ER01023.

Time-dependent behavior of the three-dimensional Sawada model is obtained by a method of recurrence relations. Exactly calculated quantities are the time evolution of the density-fluctuation operator and its random force. As an application, their linear coefficients, the relaxation and memory functions are used to obtain certain dynamic quantities, e.g., the mobility.

10602 **Nearest-neighbor correlation effects in spinless one-dimensional conductors.** Bendt, P.P. (Department of Physics, University of Colorado, Boulder, Colorado 80309). *Physical Review [Section] B: Condensed Matter;* **30**: No. 7, 3951-3962(1 Oct 1984).

Certain anisotropic conductors such as tetracyanoquinodimethane (TCNQ)= salts can be modeled as one-dimensional systems with spinless electrons. This theoretical study covered nearest-neighbor correlation effects on the ground state and the soliton excitations of these models. The results described are the first solutions of the many-body Hamiltonian for all values of the correlation strength, obtained by finding eigenvectors of very large matrices. For finite systems, the ground state has a conditional Peierls transition for all values of the correlation energy V. The trends with increasing size indicate a critical transition. The infinite systems will dimerize for Hubbard $V<2t$ and the degree of dimerization increases with V. The dimerization abruptly terminates at $V = 2t$. Similar results on the XXZ spin model are confirmed by behavior predicted using scaling relationships. The trends in soliton energy, width, and charge distribution have been calculated. Solitons are the lowest-energy charge carriers in systems which dimerize. The solitons in the spinless conductor carry fractional charge and those in the XXZ spin model have fractional spin. The charge on the most depleted site provides a useful measure of V. The solitons do not have a significant activation energy and should be highly mobile.

10603 **Pinning and annealing of solitons in modulated systems.** Jensen, M.H.; Bak, P. (Fysisk Laboratorium 1, H. C. Orsted Institute, Universitetsparken 5, Copenhagen, Denmark). *Physical Review [Section] B: Condensed Matter;* **29**: No. 11, 6280-6284(1 Jun 1984). Contract AC02-76CH00016.

Chaotic pinning of solitons occurs in nearly commensurate modulated systems when the distance between solitons becomes so large that their interaction cannot overcome the Peierls pinning potential. We study numerically within the mean-field theory the stability of the randomly pinned "chaotic" states as a function of temperature near the commensurate-incommensurate (CI) transition in the axial next-nearest-neighbor Ising model. The pinned state turns into a regular incommensurate state as the temperature is raised. A more regular soliton state emerges as the temperature is lowered. The system never reaches the ground state (Frank and van der Merwe or devil's-staircase behavior) near the CI transition because of the pinning. The chaos and the hysteresis may explain recent experimental findings in magnetic and ferroelectric systems.

6561 Superconductivity

REFER ALSO TO CITATION(S) 65610010069, 10128, 10132, 10137, 10146

10604 **(BNL—35375) Approximate closed-form expression for the electron-scattering-induced interaction between magnetic flux lines and grain boundaries.** Welch, D.O. (Brookhaven National Lab., Upton, NY (USA)). 10 Sep 1984. Contract AC02-76CH00016. 4p. (CONF-840937—26). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004699.

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

An approximate closed-form result for the interaction of an isolated magnetic flux line in a Type-II superconductor with a grain boundary, due to the scattering of electrons by the boundary, is presented here. The grain boundary need not be infinitely thin, but can include a distribution of scattering centers nearby. The resulting expressions are more suitable for computer simulations of flux pinning and their interpretation is more physically transparent than previous results; they are used here to discuss pinning by nonideal boundaries.

10605 **(IS-M—522) Anomalous magnetism of $CeRh_3B_2$ under pressure.** Shaheen, S.A.; Schilling, J.S.; Klavins, P.; Vining, C.B.; Shelton, R.N. (Ames Lab., IA (USA); Bochum Univ. (Germany, F.R.). Inst. fuer Experimentalphysik; Geneva Univ. (Switzerland). Dept. de Physique de la Matiere Condensee). 1984. Contract W-7405-ENG-82. 13p. (CONF-840876—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003069.

From International conference on valence fluctuations; Koln, F.R. Germany (27 Aug 1984).

Whereas $CeRh_3B_2$ possesses the highest magnetic ordering temperature (T/sub c/ $\simeq$ 115K) of any Ce-compound with nonmagnetic constituents, $LaRh_3B_2$ becomes superconducting below 2.5K. Recent magnetization measurements under pressure as well as lattice parameter and specific heat studies shed light on the nature of the anomalous magnetic state in $CeRh_3B_2$. 21 references, 3 figures.

10606 **(IS-T—1130) Field and temperature dependent quantum phenomena in SNS junctions.** Miller, S.L. (Ames Lab., IA (USA)). Dec 1984. Contract W-7405-ENG-82. 116p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85005118.

Thesis.

The critical current of cross type superconductor-normal metal-superconductor (SNS) junctions has been studied as a function of temperature, applied magnetic field, and junction geometry in order to understand the physical processes occurring in SNS Josephson junction devices. In the absence of an applied field, the critical current is found to follow the theory of de Gennes in the regime near the critical temperature where the theory applies. In small fields, Fraunhofer patterns of remarkable quality are obtained in the regime where self field effects are negligible. From the temperature dependence of the period of oscillation of these Fraunhofer patterns, the field penetration depth lambda (T) of the superconducting banks is inferred and the penetration depth is found to have the same functional temperature dependence as that predicted by the BCS theory. The resulting critical current surface, functions of temperature and applied parallel magnetic field, shows that quantum oscillations can be driven by temperature, in good agreement with theory. If the field is applied perpendicular to the plane of the junction the critical current is found to decrease monotonically with increasing fields, going as 1/H for large fields. The effects of individual misaligned trapped vortex pairs in the superconducting electrodes on the maximum Josephson current is examined. The critical current is found to decrease in discrete steps as more vortices are introduced into the junction. The critical current vs. field curves for junctions containing trapped vortices are found to agree qualitatively with theory.

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 65700010523, 10585

10607 **(BONN-HE—84-24) Semiclassical expansions on and near caustics.** Meetz, K. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Sep 1984. 19p. Bonn Univ. (Germany, F.R.). Physikalisches Inst.

We show that the standard WKB expansion can be generalized so that it reproduces the behavior of the wave function on and near a caustic in two-dimensional space time. The expansion is related to the unfolding polynomials of the elementary catastrophes occurring in two dimensions: the fold and the cusp catastrophe. The method determines control parameters and transport coefficients in a self-consistent way from differential equations and does not refer to the asymptotic expansion of Feynman path integrals. The lowest order equations are solved explicitly in terms of the

multivalued classical action. The result is a generalized semiclassical approximation on and beyond a caustic.

10608 **(LUTMDN/TMVK—1005/1-225) Thermodynamic analysis of district heating.** Frederiksen, S. (Tekniska Hoegskolan, Lund (Sweden). Institutionen foer Vaerme- och Krafteknik). 1982. 224p. Tekniska Hoegskolan, Institutionen foer Vaerme- och Krafteknik, Lund, Sweden. File Number TI85750188.

The thesis presents a thermodynamic analysis of district heating (DH) systems based on the circulation of hot pressurized water, utilizing heat from a back-pressure steam power plant. Performance characteristics for simple models of such systems are calculated. A main variable selected for analysis is the net electric output, defined as the turbo-alternator output reduced by the power consumption of the DH pump maintaining the hot water flow. The size of this variable is calculated for various values for DH design parameters and for various load conditions; these include both changes in heat load and in DH operational strategy, given by the water mass flowrate and by the water supply temperature. The numerical results derived are shown in diagrams, utilizing alternative graphical techniques to demonstrate various aspects of system performance. Calculations are made for two system models. In both models the DH network is simplified to consist of a single pair of supply and return pipes, serving a single (big) heat consumer at a distance from the plant. The steam plants are based on a simple Clausius-Rankine cycle with no regenerative feedwater heating. The first model supposes space heating only for the building, and relies on the back-pressure plant alone to cover the heat load. In the second and more realistic model, hot water services are provided for as well, and a peak heat-only boiler is connected in series with the back-pressure plant.

10609 **Stimulated Raman scattering of colored chaotic light.** Trippenbach, M.; Rzazewski, K.; Raymer, M.G. (Institute for Theoretical Physics, Polish Academy of Sciences, Aleja Lotnikov 32/46, 02-668 Warsaw, Poland). *Journal of the Optical Society of America B: Optical Physics;* **1**: No. 4, 671-675(Aug 1984). Contract AC02-81ER10979.

The quantum theory of forward Stokes generation by means of stimulated Raman scattering is extended to the case of a colored (finite-bandwidth) chaotic pump, which has both amplitude and phase fluctuations. In both transient and steady-state limits the mean Stokes intensity is found to be enhanced over that resulting from a coherent pump. In the limit that the chaotic-pump bandwidth becomes large, the mean Stokes intensity becomes identical with that resulting from a coherent pump of the same total power.

10610 **Free energy of a planar two-phase interface.** Percus, J.K. (Courant Institute of Mathematical Sciences and Physics Department, New York University, New York, New York 10012). *Journal of Chemical Physics;* **81**: No. 1, 452-454(1 Jul 1984). Contract AC02-76ER03077.

The linear liquid—gas interface of a two-dimensional fluid is modeled by a membrane separating vacuum and incompressible liquid. The density reaction to an arbitrary external potential is written down exactly in the form of the inverse relation. From this, the system free energy is obtained as a functional of the resulting density. It is local, but highly singular, and cannot readily be interpreted as an extension of local thermodynamics.

10611 **Supersymmetry and the Bistable Fokker-Planck equation.** Bernstein, M.; Brown, L.S. (Department of Physics, University of Washington, Seattle, Washington 98195). *Physical Review Letters;* **52**: No. 22, 1933-1935(28 May 1984). Contract AC06-81ER40048.

The approach to equilibrium in a bistable system is governed by a small eigenvalue which appears to be difficult to compute. We show that supersymmetry makes possible an easy evaluation of this eigenvalue.

10612 **One-dimensional classical many-body system having a normal thermal conductivity.** Casati, G.; Ford, J.; Vivaldi, F.; Visscher, W.M. (Istituto di Scienze Fisiche, Universita degli Studi di Milano, 1-20133 Milano, Italy). *Physical Review Letters;* **52**: No. 21, 1861-1864(21 May 1984). Contract AS05-81ER40003.

By numerically computing orbits for a chaotic, one-dimensional, many-body system placed between two thermal reservoirs, we verify directly that its energy transport obeys the Fourier heat law and we determine its thermal conductivity K. The same value of K is independently obtained by use of the Green-Kubo formalism. These numerical studies verify that chaos is the essential ingredient of diffusive energy transport, and they validate the Green-Kubo formalism.

10613 **Vacuum topology and incoherence in quantum gravity.** Strominger, A. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Physical Review Letters;* **52**: No. 20, 1733-1736(14 May 1984). Contract AC02-76ER02220.

An explicit expression is derived for the quantum gravitational vacuum state by use of the saddle-point approximation and a conformally invariant action. It consists of a superposition of zero-energy classical vacua that differ in the topology both of the local Lorentz frames (leading to CP nonconservation) and of space itself. Space is found to have Planck-size wormholes and spinorial knots, and is surrounded by a vapor of disconnected submanifolds. The scattering matrix constructed on this vacuum is not unitary but the superscattering matrix conserves probability.

10614 **Solving the secular equation including spin orbit coupling for systems with inversion and time reversal symmetry.** Dongarra, J.J.; Gabriel, J.R.; Koelling, D.D.; Wilkinson, J.H. (Mathematics and Computer Science Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439). *Journal of Computational Physics;* **54**: No. 2, 278-363(May 1984). Contract W-31-109-ENG-38.

A computational method for computing the eigenvalues and eigenvectors of a class of matrices that arise in quantum mechanics involving time reversal and inversion symmetry is described. The algorithms presented have greatly reduced the computational effort required to solve this problem and also produce a stable, more accurate solution.

10615 **Interaction Hamiltonian of quantum optics.** Ackerhalt, J.R.; Milonni, P.W. (Box 1663, MS-J569, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of the Optical Society of America B: Optical Physics;* **1**: No. 1, 116-120(Mar 1984).

We consider the fully quantum-mechanical Hamiltonian for the interaction of light with bound electrons. There are, roughly speaking, two different viewpoints relating the minimal-coupling and electric-dipole forms of the Hamiltonian. We attempt to clarify the situation by showing that either viewpoint is justified. As an example we discuss the Maxwell-Bloch equations and show that the usual derivation of these equations is somewhat misleading. In addition, we find that the Maxwell-Bloch equations appearing inn standard texts are inconsistent.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 65800010614

10616 **(SAND—82-0572) Estimation theory applied to improving dynamic structural models.** Martinez, D.R. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004148.

This paper presents a summary of key results from the field of estimation theory. In particular, results are given which are applicable to the problem of improving dynamic structural models to agree with test data. This problem is referred to as structural dynamics parameter identification or reconciliation of analytical models. Pertinent results from both parameter and state estimation

are discussed as background information for the development of the iterated Extended Kalman Filter (EKF) for parameter estimation. The well-known Lease Squares parameter estimation algorithms are presented for the cases of batch linear estimation, recursive linear estimation, and iterative batch nonlinear estimation. Included are a definition of related parameter estimation algorithms and a discussion of the conditions required for their commonality. Next, the linear Kalman Filter and Extended Kalman Filter equations for optimal state estimation are given, as well as a discussion of the additional generality introduced to obtain the iterated EKF equations. The structural dynamics parameter identification problem is then imbedded into the more general state estimation framework as a special simplified case. An extensive reference list is included.

70 FUSION ENERGY

7001 Plasma Research

REFER ALSO TO CITATION(S) 70010010659, 10693, 10702, 10707, 10711, 10735, 10736, 10744, 10758, 10759, 10764

10617 **(AD-A—144936/2) MHD (magnetohydrodynamics) instabilities in simple plasma configuration.** Manheimer, W.M.; Lashmore-Davies, C. (Naval Research Lab., Washington, DC (USA)). 1984. 107p. NTIS, PC A06/MF A01.

This work provides what, we hope, is a relatively simple, self contained description of MHD instabilities in plasmas with simple configurations. By simple configuration, we mean a plasma in which all quantities vary in only one spatial direction. We deal with such plasmas here because we want to emphasize the basic physics of MHD instabilities. Although some fusion devices are inherently two or three dimensional in nature, there are others, specifically tokamaks and reversed field pinches which are, to good approximation, one dimensional. Also, these devices both display a wealth of complex MHD activity which can be fruitfully discussed. One deceptive aspect of MHD instabilities is that the simplest ones are extremely easy to understand. However more complicated instabilities, for instance in a plasma where both an axial and azimuthal field are present are much more difficult to visualize; but they are also much more interesting. This work is divided into two parts. Chapters 2-9 describe linear theory and chapters 10-15 describe the nonlinear theory. The latter part is naturally much more speculative than the former because less is known about nonlinear theory.

10618 **(AD-A—145155/8) K-shell yield scaling law for conventional PRS loads. Memorandum report.** Apruzese, J.P.; Davis, J. (Naval Research Lab., Washington, DC (USA)). 31 Aug 1984. 22p. (NRL-MR—5406). NTIS, PC A02/MF A01.

The simplified equation of motion for a Z-pinch implosion is combined with an empirical sealing law for K-shell yield as a function of temperature and density, and also with power law fits to K-shell atomic data to predict K-shell yields as a function of atomic number and generator power. Assuming the efficiency of future machines to approximate that of existing generators leads to the conclusion that argon will be a prolific PRS with generator powers of approx. = 25 TW while titanium will require approx. = 40 TW. Conventional iron and krypton loads will require generators in the 50-100 TW range to be efficient K-shell radiators.

10619 **(CONF-841010—11) Plasma performance of TFCX and jet with sawtoothing.** Hively, L.M.; Mikkelsen, D.R. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC02-76CH03073. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003335.

From Meeting of the Plasma Physics Division of the American Physical Society; Boston, MA, USA (27 Oct 1984).

10620 **(CONF-841010—12) TMRBAR power balance code for tandem mirror reactors.** Blackkfield, D.T.; Campbell, R.; Fenstermacher, M.; Bulmer, R.; Perkins, L.; Peng, Y.K.M.; Reid, R.L.; Wu, K.F. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003333.

From Meeting of the Plasma Physics Division of the American Physical Society; Boston, MA, USA (27 Oct 1984).

10621 **(CONF-841010—13) Parametric assessments of current rampup by Lower Hybrid Current Drive in TFCX.** Freije, S.A.; Peng, Y.K.M. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003682.

From Meeting of the Plasma Physics Division of the American Physical Society; Boston, MA, USA (27 Oct 1984).

A lower hybrid current drive code has been developed from two previous existing codes which incorporates the eikonal (WKB) approximation in toroidal canonical variables and an analytic treatment of quasi-linear absorption. Ray-tracing is performed for a 5 to 9 ray spectrum in a nonuniform, circular plasma with the local warm plasma dispersion relation. A parameter study in n/sub e/, T/sub e/, n/sub parallel/, and frequency is being carried out for two startup scenarios (i.e., expanding radius at the outboard midplane and full radius startup on the toroidal axis) for the superconducting toroidal field coil TFCX device. Driven current profiles and current drive efficiencies for both a Maxwellian background plasma and an electron distribution with an rf-enhanced tail are presented.

10622 **(DOE/ER/53175—T1) Collisional processes of interest in MFE plasma research. Annual report, October 1, 1983-September 30, 1984.** Olson, R.E. (Missouri Univ., Rolla (USA). Dept. of Physics). 25 Oct 1984. Contract FG02-84ER53175. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004307.

Research on this contract can be divided into two general topics: (1) D^- formation collision processes; and (2) the determination of scattering cross sections used to diagnose properties of magnetically-confined plasmas. For topic (1) during last year, we completed theoretical calculations on D^- negative ion formation from collisions of D atoms with Na and Cs targets. On the topic of research into polarized sources of H or He, we completed cross section studies of metastable He production in electron capture collisions of He^+ with Li and Na and of nuclear spin exchange collisions between H and the alkali metals. For diagnostic efforts, electron capture cross sections were determined for Al^{2+} and Al^{3+} colliding with H for the EBT program and C^{4+}, C^{6+}, Ar^{8+} colliding with He for helium ash studies. Work is proceeding on laser-assisted collisions to enhance D^- negative ion yields and the effects of l-mixing in collisions of He^+(nl) with plasma constituents.

10623 **(DOE/ET/51013—97) Comments on equilibrium plasma flows in the limiter shadow region of Alcator C.** LaBombard, B. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Nov 1984. Contract AC02-78ET51013. 35p. (PFC/RR—83-26). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004846.

Resistive MHD is used to examine bulk plasma flows in the limiter shadow region of Alcator C. Expressions for the Pfirsch-Schlueter perpendicular plasma flow velocities are obtained for a toroidal system in which the pressure profile depends on radius only. Data from Langmuir probe measurements in the shadow of the limiter is used to estimate the magnitude of this plasma convection.

10624 **(N—84-25461) Start-up and quasi-stationary drive of plasma current by lower hybrid wave in the JPII T-IIU Tokamak.** Toi, K.; Ohkubo, K.; Kawahata, K.; Kawasumi, Y.; Matsuoka, K.; Noda, N.; Ogawa, Y.; Sato, K.; Tanahashi, S.; Tetsuka, T. (Nagoya Univ. (Japan)). Feb 1984. 13p. (IPPJ—667). NTIS, PC A02/MF A01.

A plasma current is initiated and raised up to a quasi-stationary level of about 20 kA by injecting the lower hybrid wave into a cold and low density plasma produced by electron cyclotron resonance. The plasma current rises more slowly than the experimentally obtained L sub p/R sub p magnetic diffusion time of the bulk plasma. The current rise time decreases with the increase of the bulk electron density, and agrees well with the collision time of the current-carrying high energy electrons with the bulk plasma.

10625 (N—84-25462) Heavy ion beam probe for the study of plasma confinement in Nagoya bumpy torus. Takasugi, K.; Iguchi, H.; Fujiwara, M.; Ikegami, H. (Nagoya Univ. (Japan)). Mar 1984. 42p. (IPPJ—669). NTIS, PC A03/MF A01.

The heavy ion beam probing system was constructed for the study of plasma confinement in the Nagoya Bumpy Torus (NBT-1/1M). Not only the plasma space potential but also the electron density multiplied by a function of the electron temperature nf(T sub e) can be measured with a good spatial resolution. The feedback controlled detection technique is used for steady state measurements, and the time resolved fast detection technique is used for pulsed measurements. The effects of the hot electron beta and the plasma space potential on the beam orbit were analyzed. It is confirmed that these effects on the observation points are usually small and neglected in standard operation modes. The possibility of the measurement of the hot electron beta from the shifts of the primary beam orbits is also discussed.

10626 (N—84-26191) STS-3/OSS-1 Plasma Diagnostics Package (PDP) measurements of Orbiter-generated V x B potentials and electrostatic noise. Shawhan, S.D.; Murphy, G.B. (Iowa Univ., Iowa City (USA)). Jan 1983. 5p. (AD-P—002105). NTIS, PC A18/MF A01.

In AFGL, proceedings of the AFGL workshop on national charging of large space structures in near earth polar orbit, 119-123, N—84-26185 16-46.

The Plasma Diagnostics Package (PDP) was flown as part of OSS-1 pallet on the Space Shuttle fight STS-3 in March 1982. During this eight-day mission, the PDP was operated in its pallet position and on the Remote Manipulator System. PDP measurements included dc electric and magnetic fields, ac magnetic fields to 100 kHz; ac electric fields to 800 MHz and at S-band, energetic ions and electrons from 2.5 eV to 50 KeV; total electron flux; the ion mass spectrum, energy distribution, and streaming direction the electron density and temperature, and the neutral pressure.

10627 (N—84-26410) Microwave discharges in capillary tubes. Dervisevic, E.; Bloyet, E.; Laporte, C.; Saada, S. (Paris-11 Univ., 91 - Orsay (France)). Feb 1984. 120p. (In French). (LP—203). NTIS, PC A06/MF A01.

Discharges of argon in a capillary tube with a diameter less than 6mm were studied and the discharges were macroscopically described while taking into account results already obtained for tubes with larger diameters. Fundamental equations describing the discharge are given and surface wave propagation, both radial and longitudinal, is examined. The creation of plasma, optical and electrical measuring techniques, data processing, interpretation of results, and influence of certain parameters are discussed. Components of the electromagnetic field of the wave are also considered.

10628 (N—84-26411) Role of excitation frequency in discharges created by surface waves. Boisse-Laporte, C.; Bloyet, E.; Dervisevic, E.; Laye-Granier, A.; Leprince, P.; Marec, J.; Rakem, Z.; Saada, S. (Paris-11 Univ., 91 - Orsay (France)). Mar 1984. 150p. (In French). (LP—205). NTIS, PC A07/MF A01.

Plasma columns produced by surface waves present an electron density gradient from excitation at the end of the discharge. Discharges of argon were created by surface waves under low pressure at 210 MHz and 2450 MHz. The electron densities and ionization efficiencies obtained were compared and the independent characteristics of the wave frequency were isolated. Whether the laws found at 2450 MHz (similitude law and spontaneous plasma emission) are valid at 210 MHz was investigated as well as the dependence of these laws on frequency.

10629 (ORNL/TM—9090) Feasibility of alpha particle measurement by CO_2 laser Thomson scattering. Hutchinson, D.P.; Vander Sluis, K.L.; Sheffield, J.; Sigmar, D.J. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004938.

The feasibility of O_2 laser Thomson scattering from a multicomponent burning plasma has been evaluated for the measurement of the velocity distribution of D-T produced alpha particles. The density and velocity distribution of the alpha particles from their initial energy of 3.5 MeV down to near-thermal energies may be measured by small angle ($<1^9$) Thomson scattering. A computer simulation of the experiment indicates that a 100 MW pulsed laser combined with a bank of heterodyne receivers will be able to measure a scattered signal from the alpha particles with a post-detection signal-to-noise ratio of 75 for an assumed alpha density of 7.5×10^{11} cm^{-3}.

10630 (ORNL/TM—9296) Noninductive current drive in tokamaks. Uckan, N.A. (Oak Ridge National Lab., TN (USA)). Jan 1985. Contract AC05-84OR21400. 198p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85005427.

Various current drive mechanisms may be grouped into four classes: (1) injection of energetic particle beams; (2) launching of rf waves; (3) hybrid schemes, which are combinations of various rf schemes (rf plus beams, rf and/or beam plus ohmic heating, etc.); and (4) other schemes, some of which are specific to reactor plasma conditions requiring the presence of alpha particle or intense synchrotron radiation. Particle injection schemes include current drive by neutral beams and relativistic electron beams. The rf schemes include current drive by the lower hybrid (LH) waves, the electron waves, the waves in the ion cyclotron range of frequencies, etc. Only a few of these approaches, however, have been tested experimentally, with the broadest data base available for LH waves. Included in this report are (1) efficiency criteria for current drive, (2) current drive by neutral beam injection, (3) LH current drive, (4) electron cyclotron current drive, (5) current drive by ion cyclotron waves - minority species heating, and (6) current drive by other schemes (such as hybrids and low frequency waves).

10631 (PPPL—2163) Partial pressure analysis of plasmas. Dylla, H.F. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1984. Contract AC02-76CH03073. 36p. (CONF-8309103—13). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003885.

From 9. international vacuum congress and 5. international conference on solid surfaces; Madrid, Spain (26 Sep 1983).

The application of partial pressure analysis for plasma diagnostic measurements is reviewed. A comparison is made between the techniques of plasma flux analysis and partial pressure analysis for mass spectrometry of plasmas. Emphasis is given to the application of quadrupole mass spectrometers (QMS). The interface problems associated with the coupling of a QMS to a plasma device are discussed including: differential-pumping requirements, electromagnetic interferences from the plasma environment, the detection of surface-active species, ion source interactions, and calibration procedures. Example measurements are presented from process monitoring of glow discharge plasmas which are useful for cleaning and conditioning vacuum vessels.

10632 (UCRL—91802) Neutral-fueling pressure measurements and modeling near the plasma edge in TMX-U. Pickles, W.L. (Lawrence Livermore National Lab., CA (USA)). 3 Dec 1984. Contract W-7405-ENG-48. 21p. (CONF-841218—16). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004998.

From 31. national vacuum symposium; Reno, NV, USA (3 Dec 1984).

Large variations in pressure from external gas-fueling sources and from plasma-induced wall reflux along the TMX-U plasma have been observed. These pressure variations can produce locally high neutral density in the plasma, which strongly affects the plasma parameters. These local pressure measurements include data from a newly installed neutral-pressure diagnostic system of fast magnetron gauges. The plasma-induced warm-wall reflux has been observed to be primarily HD and H_2 as opposed to D_2. This observation supports the model that all of the neutral D_2 gas enters the plasma region, strikes the plasma first, and is dissociated. The part of the D_2 gas, which is not absorbed as ions, strikes a wall, where it is converted to HD. Electron induced wall desorption measured by a mass spectrograph and actual analysis of the Ti indicates predominately H_2 instead of D_2 wall loading in TMX-U.

10633 Confinement improvement in beam heated ISX-B discharges with low-Z impurity injection. Lazarus, E.A.; Bush, C.E.; Dunlap, J.L.; Edmonds, P.H.; Emerson, L.C.; Eldridge, O.C.; Gardner, W.L.; Howe, H.C.; Hutchinson, D.P.; Kindsfather, R.R. (Oak Ridge National Lab., TN (USA). Fusion Energy Div.). *Journal of Nuclear Materials;* **121**: 61-68(May 1984). (CONF-830795—). Contract W-7405-ENG-26.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Results are reported on improved confinement in the Impurity Study Experiment (ISX-B) neutral beam heated plasmas when a small amount of neon is injected shortly after the start of beam heating. The scaling of energy confinement is modified by the introduction of a dependence on line-averaged density. Calculations show the improvement is primarily caused by a reduction in electron heat conduction.

10634 Impurity generation during intense lower hybrid heating experiments on the Alcator C tokamak. Marmar, E.; Foord, M.; Labombard, M.; Lipschultz, B.; Moreno, J.; Rice, J.; Terry, J.; Lloyd, B.; Porkolab, M.; Schuss, J. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). *Journal of Nuclear Materials;* **121**: 69-74(May 1984). (CONF-830795—). Contract AC02-78ET51013.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Experiments are underway on the Alcator C tokamak with over 1 MW of RF power injected into the plasma at a frequency of 4.6 GHz to study both heating and current drive effects. During these studies, impurity generation from limiter structures has been observed. The RF induced impurity influx is a strongly nonlinear function of net injected power. For Psub(RF) $<$ 500 kW, only small effects are seen. As Psub(RF) approaches 1 MW, however, sharp increases in impurity influxes and Zsub(eff) are observed. Three different limiter materials have been used during these studies: molybdenum, graphite, and silicon-carbide coated graphite. In each case, the materials of the limiter structure are seen to dominate the increased impurity influx. In a typical case, with Psub(RF) = 1.0 MW, anti nsub(e) = 1.3 x 10^{14} cm^{-3}, and the SiC coated limiters, Zsub(eff) is seen to increase from 1.5 before the RF pulse to about 4 during the heating. At the same time, central Tsub(e) increases from 2000 to 3000 eV and central Tsub(i) from 1200 to 1800 eV. Similar effects are seen in both H_2 and D_2 working gas discharges. The contribution to impurity generation of nonthermal electrons, which are produced by the RF, is under investigation. Changes in edge plasma temperature and density, as well as the possibility that the particle transport is affected by the RF, are also being examined. Results of the experiments with the three different limiter materials are compared, and contributions of impurity radiation to the overall power balance are estimated.

10635 Attainment of high confinement in neutral beam heated divertor discharges in the PDX tokamak. Kaye, S.M.; Bell, M.G.; Bol, K.; Brau, K.; Buchenauer, D.; Budny, R.; Crowley, T.; Darrow, D.S.; Eubank, H.; Fonck, R.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **121**: 115-125(May 1984). (CONF-830795—). Contract AC02-76CH03073.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Also published as report PPPL--2056.

The PDX divertor configuration has recently been converted from an open to a closed geometry to inhibit the return of neutral gas from the divertor region to the main chamber. Since then, operation in a regime with high energy confinement in neutral beam heated discharges (ASDEX H-mode) has been routine over a wide range of operating conditions. These H-mode discharges are characterized by a sudden drop in divertor density and Hsub(α) emission and a spontaneous rise in main chamber plasma density during neutral beam injection. The confinement time is found to scale nearly linearly with plasma current, but can be degraded due either to the presence of edge instabilities or heavy gas puffing. Detailed Thomson scattering temperature profiles show high values of Tsub(e) near the plasma edge (approx. = 450 eV) with sharp radial gradients (approx. = 400 eV/cm) near the separatrix. Density profiles are broad and also exhibit steep gradients close to the separatrix.

10636 Particles and field lines outside the ATF plasma. Lyon, J.F.; Rome, J.A. (Oak Ridge National Lab., TN (USA)); Lynch, V.E. (Union Carbide Corp., Oak Ridge, TN (USA). Computer Sciences Div.). *Journal of Nuclear Materials;* **121**: 415-421(May 1984). (CONF-830795—). Contract W-7405-ENG-26.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

A careful examination of particle orbits and field lines outside the Advanced Toroidal Facility (ATF) torsatron plasma was part of the ATF design process. There is no evidence of a separatrix in the flux topology outside the last, nested closed flux surface. Plasma particles go far outside the bulk of the plasma but are mirrored off the helical field (HF) coils and return to the plasma. When the current density in the HF coils is increased, direct collisionless orbit losses to the wall are almost entirely eliminated. Most ions reach the wall via charge exchange. The resulting flux is spread uniformly over the wall. The base ATF configuration can probably operate without a material limiter, and a divertor or pumped limiter is also a possibility.

10637 Particle and heat flux measurements in PDX edge plasmas. Budny, R.; Manos, D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **121**: 41-47(May 1984). (CONF-830795—). Contract AC02-76CH03073.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Also published as report PPPL--2065.

This paper describes the use of novel combined Langmuir-calorimeter probes to measure edge plasma conditions near the midplane in PDX. The probes consisted of up to five Langmuir probes and up to two calorimeters. Single and double probe characteristics yield nsub(e) and Tsub(e) which are compared with results derived from a triple probe analysis. The calorimeters measure heat flux in the electron and ion drift directions. This paper presents time-resolved radial profiles of nsub(e), Tsub(e), Vsub(F) (floating potential), and P (heat flux) during high power neutral beam-heated, single-null discharges and circular scoop limiter discharges. The temporal dependence of these quantities displays the previously observed behavior with respect to gross discharge characteristics; however, an additional dependence on confinement mode has been observed. During the H-mode of energy confinement, a transient depression of nsub(e), Tsub(e), and P occur in the scrape-off plasma.

10638 Survey of atomic processes in edge plasmas. Janev, R.K.; Post, D.E.; Langer, W.D.; Evans, K.; Heifetz, D.B.; Weisheit, J.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **121**: 10-16(May 1984). (CONF-830795—). Contract AC02-76CH03073.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Also published as report PPPL--2045.

A review of the most important reactions of atomic and molecular hydrogen with the fusion edge plasma electrons and ions is presented. An appropriate characterization of the considered collisions processes useful in plasma edge studies (evaluated cross sections, reaction rates, energy gain/loss per collision, etc.) has been performed. While a complete survey of atomic physics of fusion edge plasmas will be given shortly elsewhere, we demonstrate here the relevance of the atomic collision processes for describing the physical state of edge plasmas and understanding the energy balance in cool divertor plasmas. It is found that the excited neutral species play an important role in the low-temperature, high-density plasmas.

10639 Probe measurements of the PDX divertor plasma in ohmic and neutral beam heated discharges. Owens, D.K.; Kaye, S.M.; Fonck, R.J.; Schmidt, G.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **121**: 29-35(May 1984). (CONF-830795—). Contract AC02-76CH03073.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

A graphite-shielded probe was recently installed in the divertor region of PDX to continuously monitor local electron temperature, electron density (from the ion saturation current), and plasma floating potential throughout divertor discharges. In ohmically heated deuterium plasmas, the electron temperature near the separatrix was 6 to 12 eV; these values confirm the low Tsub(e) inferred from the density dependence of Balmer line emission from the divertor plasmas. During neutral beam heating, PDX divertor discharges were characterized by a sharp transition at which time the main chamber plasma density increased rapidly, the divertor Hsub(α) emission dropped, and the global energy confinement increased abruptly. At later times, edge relaxation oscillations, characterized by spikes in the Hsub(α) emission, occurred and were accompanied by a clamp in the density rise and lower confinement time. Limited scans of the temperature and density measured by the divertor probe indicated that these parameters changed with discharge conditions primarily near the separatrix. With the onset of neutral beam injection the temperature and density rose by a factor of 1.5 and 2-4 respectively. Transient drops in Tsub(e) to values as low as 2 eV and concomitant rises in nsub(e) were sometimes observed near the time of the transition into the high confinement mode. Later in the discharge, the values returned to their pre-H-mode level. TV camera observations of the divertor probe revealed a 'shadow' along the field lines indicating a well-defined flow in the vicinity of the separatrix.

10640 **Neutral beam driven impurity flow reversal in tokamaks.** Stacey, W.M. Jr.; Bennett, R.B. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering); Sigmar, D.J. (Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials;* **121**: 82-91(May 1984). (CONF-830795—).

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Also published as report GTFR--42.

A theory is outlined for explaining the observed effects of neutral beam injection on impurities in tokamak plasmas. In the collisional regime, it is shown for a representative model problem that for sufficiently strong co-injection the outward impurity flux component produced by the radial electric field becomes larger than the inward flux components due to the density gradient, rotation and direct beam-impurity momentum exchange, thereby producing an outward impurity flux. In the mixed regime, a preliminary version of the theory provides a reasonable interpretation of the PLT impurity flow reversal experiments when the effective viscous drag coefficient that is observed experimentally is used in the model. This preliminary theory, when adjusted to match the PLT results, predicts significant impurity reversal in TFTR and in a plasma of the size of FED and INTOR.

10641 **Effect of alpha drift and instabilities on tokamak plasma edge conditions.** Miley, G.H.; Choi, C.K. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). *Journal of Nuclear Materials;* **121**: 92-99(May 1984). (CONF-830795—). Contract AC02-76ET52040.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Also published as report CONF-830795--2; COO--2218-290.

As superthermal fusion products slow down in a tokamak, their average drift is inward. The effect on the alpha heating and thermalization profiles is examined. In smaller TFTR-type devices, heating in the outer region can be cut in half. Also, the fusion-product energy-distribution develops a positive slope, representing a possible driving mechanism for microinstabilities. Another instability that can seriously affect outer plasma conditions, shear Alfven transport of alphas, is also considered.

10642 **Energy balance of divertor discharges in the PDX tokamak.** Bell, M.G.; Fonck, R.J.; Grek, B.; Jaehnig, K.P.; Kaita, R.; Kaye, S.M.; McBride, T.; Mueller, D.; Owens, D.K.; Schmidt, G.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **121**: 132-137(May 1984). (CONF-830795—). Contract AC02-76CH03073.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

The energy balance of divertor discharges in the PDX tokamak has been studied as a function of the divertor geometry, heating method, and discharge parameters. In the original open divertor geometry, energy flow to the neutralizers accounted for 50 - 60% of the input energy, while radiation from the main plasma accounted for 20 - 40%, depending on the density and the heating source. For single-null discharges in the modified closed divertor geometry, the main plasma radiation remains at a similar level, but the neutralizer deposition decreases to $< 20\%$ and radiation from the divertor scrape-off must be included to achieve energy accountability. The energy deposition width on the neutralizers is found to vary with plasma conditions in the closed geometry.

10643 **Role of particle recycling in beam heated expanded boundary divertor discharges in D-III.** Ohyabu, N.; Brooks, N.H.; Burrell, K.H.; DeBoo, J.C.; Ejima, S.; Stambaugh, R.D.; Taylor, T.S.; Zawadski, G. (GA Technologies, Inc., San Diego, CA (USA)). *Journal of Nuclear Materials;* **121**: 157-163(May 1984). (CONF-830795—). Contract AT03-76ET51011.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Discharges with improved energy confinement are produced in Doublet III when the major recycling locations is shifted away from the main plasma by forming an expanded boundary (XB) divertor configuration with a separatrix to limiter separation $\Delta > 1.5$ cm. Monte Carlo calculations indicate that over a wide range in density the divertor plasma effectively limits the penetration of recycled neutrals to the main plasma. This results in large particle recycling rates at the divertor plates and a reduction of particle recycling near the main plasma. This divertor function apparently plays an important role in obtaining improved energy confinement. Particle containment, as inferred from variations in Dsub(α) emission near the main plasma, is found to decrease with anti nsub(e) and Bsub(T), and increases rapidly (faster than quadratic) with Isub(p) whereas energy confinement is relatively insensitive to variations in anti nsub(e) and Bsub(T) and increases linearly with Isub(p). This improved energy confinement with the XB divertor configuration is suggestive of particle confinement playing an important role. However, in view of their rather different parametric dependences, the correlation between tausub(p) and tausub(E), if any, remains unclear.

10644 **Two-point transport model for cold divertor plasmas.** Galambos, J.D.; Peng, Y.K.M. (Oak Ridge National Lab., TN (USA). Fusion Engineering Design Center). *Journal of Nuclear Materials;* **121**: 205-209(May 1984). (CONF-830795—). Contract W-7405-ENG-26.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

A two-point model for plasma transport along divertor field lines is presented here. Solutions for the steady-state plasma temperature, density, and flow speed at the divertor throat and plate are found for a given throat heat flux, divertor field line length, neutral recycling coefficient, and throat density. Because of the simplicity of the model, it is useful for parameter surveys and indications of general trends. Results from the model show that more than one steady-state solution can exist for a particular throat density and that the range of throat densities for which solutions exist is limited. Also, for a constant plasma flux at the divertor throat, as neutral recycling increases, the throat density must also increase to compensate for a large decrease in plasma flow speed at the throat.

10645 **Fast alpha diffusion and thermalization in tokamak reactors.** Attenberger, S.E.; Houlberg, W.A. (Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* **4**: No. 2, 129-134(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Energy relaxation and spatial diffusion of fast alpha particles are incorporated into a multienergy group model which is coupled to a fluid transport code for the thermal plasma species. The multienergy group equations evolve the temporal- and spatial-dependent alpha particle distribution function and thus determine alpha particle heating and loss rates for arbitrary thermalization and diffusion models. The effects of deviations from classical, local thermali-

zation on plasma performance are discussed. It is shown that spatial diffusion can lead to inversion of the fast ion distribution function even if thermalization remains classical. This inversion may drive instabilities and lead to anomalous thermalization. Ripple-induced spatial diffusion of fast alphas is used to illustrate the importance of extending the analysis to include pitch angle dependence.

10646 **Proposed rf-technology RandD plan for the United States.** Becraft, W.R. (General Electric Co., Oak Ridge, TN (USA)); Eldridge, O.C.; Haselton, H.H.; Hoffman, D.J.; Ponte, N.S. (Oak Ridge National Lab., TN (USA)); Haas, G.M. (Department of Energy, Washington, DC (USA)); Kortman, P.J. (Science Applications, Inc., Gaithersburg, MD (USA)). pp v.1 p.193-197 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. 2 v. Oxford ,UK.; Pergamon Press (1983). (CONF-820948—). Contract W-7405-ENG-26.

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound125.00.

The planned use of rf energy in the U.S. magnetic confinement devices has increased significantly in the past few years. An attendant growth in programs to develop rf technology to support physics experiments and to prepare for future reactor-like machines is needed. A summary is presented of a proposed plan, with emphasis on the 1983 program, as prepared with the assistance of U.S. laboratories, universities, and industries with major involvement in rf uses for fusion. The major efforts in 1983 include: specific coupler development, design and fabrication of test facilities, and the detailed assessment of the need for higher power component developments.

7002 Fusion Power Plant Technology

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10647 **(AD-A—144538/6) Short-pulse laser and plasma surface interactions. Technical report.** Schwirzke, F. (Naval Postgraduate School, Monterey, CA (USA)). Apr 1984. 19p. (NPS—61-84-004). NTIS, PC A02/MF A01.

Unipolar arcing has been shown to be the primary plasma-surface interaction process when a laser produced plasma is in contact with a surface. Evidence of unipolar arcing was found on targets irradiated with neodymium laser pulses of 5 ns duration. The burn pattern of a defocused low irradiance laser pulse consists exclusively of unipolar arc craters. No other damage is observable.

10648 **(ANL/FPP/TM—183) Tritium catalyzed deuterium tokamaks.** Greenspan, E.; Miley, G.H.; Jung, J.; Gilligan, J. (Argonne National Lab., IL (USA)). Apr 1984. Contract W-31-109-ENG-38. 62p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004825.

A preliminary assessment of the promise of the Tritium Catalyzed Deuterium (TCD) tokamak power reactors relative to that of deuterium-tritium (D-T) and catalyzed deuterium (Cat-D) tokamaks is undertaken. The TCD mode of operation is arrived at by converting the ^{3}He from the D(D,n)^{3}He reaction into tritium, by neutron capture in the blanket; the tritium thus produced is fed into the plasma. There are three main parts to the assessment: blanket study, reactor design and economic analysis and an assessment of the prospects for improvements in the performance of TCD reactors (and in the promise of the TCD mode of operation, in general).

10649 **(DOE/ER/52111—1) Application of railgun principle to high-velocity hydrogen pellet injection for magnetic fusion reactor refueling. Technical progress report.** Kyekyoon, K. (Illinois Univ., Urbana (USA). Dept. of Electrical and Computer Engineering). 24 Nov 1984. Contract FG02-84ER52111. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004284.

A brief review of the program and its status is given. (MOW)

10650 **(DOE/ET/51013—98) Spline techniques for magnetic fields.** Aspinall, J.G. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 8 Jun 1984. Contract AC02-78ET51013. 72p. (PFC/RR—83-27). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004919.

This report is an overview of B-spline techniques, oriented toward magnetic field computation. These techniques form a powerful mathematical approximating method for many physics and engineering calculations. In section 1, the concept of a polynomial spline is introduced. Section 2 shows how a particular spline with well chosen properties, the B-spline, can be used to build any spline. In section 3, the description of how to solve a simple spline approximation problem is completed, and some practical examples of using splines are shown. All these sections deal exclusively in scalar functions of one variable for simplicity. Section 4 is partly digression. Techniques that are not B-spline techniques, but are closely related, are covered. These methods are not needed for what follows, until the last section on errors. Sections 5, 6, and 7 form a second group which work toward the final goal of using B-splines to approximate a magnetic field. Section 5 demonstrates how to approximate a scalar function of many variables. The necessary mathematics is completed in section 6, where the problems of approximating a vector function in general, and a magnetic field in particular, are examined. Finally some algorithms and data organization are shown in section 7. Section 8 deals with error analysis.

10651 **(DOE/ET/51013—127) Design and performance of compact submillimeter beam dumps.** Kato, K.; Hutchinson, I.H. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Jul 1984. Contract AC02-78ET51013. 27p. (PFC/RR—84-11). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004959.

Several different beam dumps using parallel groove structures were made for use in absorbing electron cyclotron radiation emitted from fusion plasmas. The materials used were Pyrex, Macor, alumina, and graphite. Broadband absorption measurements indicate more than 99% power absorption for dumps made of Pyrex and Macor, while absorption by alumina and graphite dumps are noticeably less. Waves polarized with E parallel to the grooves undergo higher absorption compared to those polarized with E perpendicular to the grooves. Three different mechanisms are identified as the source of reflected power. They are: (1) front surface reflection; (2) back surface reflection; and (3) diffraction grating effect. All the dumps exhibit greater reflection at lower frequencies.

10652 **(DOE/ET/51013—129) ICRF antenna coupling theory for a cylindrically stratified plasma.** McVey, B. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Jul 1984. Contract AC02-78ET51013. 111p. (PFC/RR—84-12). NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE850\4960.

Antenna coupling to a cyclindrical plasma is examined for the ion cyclotron range of frequencies (ICRF). A variety of antenna configurations are modelled such as a partial-turn loop, Nagoya coils, an aperture antenna, and arrays of coils. A procedure that utilizes the induction theorem is presented which replaces a general coil configuration with an equivalent representation in terms of sinusoidal current sheets. This transformation reduces the three dimensional antenna boundary value problem to that of one dimension (r, the radial coordinate) with the spatial variation in the other directions represented by complex exponentials (exp (in phi + ik/ sub z/z)). As constructed, the transformation is directly applicable to axisymmetric geometries where the plasma parameters are only functions of radius. The radial variation of the plasma parameters such as the local density and temperature are approximated by a stratified model. As the number of strata are increased, the stepwise model is shown to converge to the continuous case. The plasma response is modelled by a local equivalent dielectric tensor. In the context of this model antenna-plasma coupling characteristics are compared for the various ICRF antennas.

10653 (DOE/ET/51013—130) ANTENA user guide. McVey, B. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Jul 1984. Contract AC02-78ET51013. 31p. (PFC/RR—84-13). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004961.

Use of the computer code ANTENA is described. The code calculates the vacuum fields and the linear self-consistent plasma fields for a variety of ICRF antenna configurations.

10654 (EGG-M—26084) Activation product release from fusion structural materials. Maya, I.; Montgomery, F.; Tresster, P.; Burnette, R.; Johnson, W.; Schultz, K. (GA Technologies, Inc., San Diego, CA (USA)). 1984. Contract AC07-76ID01570. 17p. (CONF-841246—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003945.

From 1. international conference on fusion reactor materials; Tokyo, Japan (3 Dec 1984).

The release and transport of activated materials-of-construction in a fusion reactor during an accident scenario involving overheating and ingress of oxidants is an important area of safety research. This investigation quantified material release characteristics which result from surface oxide spallation and vaporization for the steel alloys PCA and HT-9 in air and helium environments. Flowing air and helium, each containing specific quantities of O_2 and H_2O, were used to oxidize test sample surfaces at temperatures of 800° and 1000°C for exposure times of <200 h. The changes and features observed are described and include: weight, oxide scale morphology, adherence and composition; alloy composition (including decarburization); and vaporization as fractional loss of alloying elements. Oxide scales formed were dominant in Mn and Cr but minor in Fe. The dominant volatilized elements detected were Mo, W, Cr, As, Mn and Sb. The implications of these data for safety analyses of activated material release are that following an accident exposure to 800°C, material transport by scale spallation and or volatilization should be minor, in contrast to the potentially higher consequences of exposure to 1000°C.

10655 (LA-UR—84-3576) Numerical models of CTX equilibrium. Marklin, G. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-8411111—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003742.

From Japan/US joint symposium on compact toroid research; Hiroshima, Japan (13 Nov 1984).

The open mesh flux conserver (MFC) of the Los Alamos spheromak (CTX) is equipped with Rogowski loops that measure the current in many of its individual segments. The distribution of induced current in the toroidal hoops of the MFC can be used to construct numerical models of the CTX equilibrium.

10656 (N—84-25458) Magnetohydrodynamic power generation. Smith, J.L. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). May 1984. 36p. (NASA-TP—2331). NTIS, PC A03/MF A01.

Magnetohydrodynamic (MHD) Power Generation is a concise summary of MHD theory, history, and future trends. Results of the major international MHD research projects are discussed. Data from MHD research is included. Economics of initial and operating costs are considered.

10657 (N—84-25463) Ablation accelerator (ABLAC) as driver for impact fusion. Ikuta, K.; Ueno, I. (Nagoya Univ. (Japan)). Feb 1984. 16p. (IPPJ—668). NTIS, PC A02/MF A01.

The design of an ablation accelerator suitable as driver for impact fusion and of a projectile to be accelerated by the accelerator is discussed. The proposed approach which offers an attractive option to accelerate the iron projectile to a hypervelocity suitable to fusion applications uses a relativistic electron beam which can be transported from the beam source to the projectile for ablation the base of the projectiles. The base of the projectile is irradiated intermittently by a series of electron sources arranged by the path of the projectile.

10658 (PPPL—2159) Experimental observations of the coupling between induced currents and mechanical motion in torsionally supported square loops and plates. Part 2. Data inventory. Weissenburger, D.W.; Bialek, J.M.; Cargulia, G.J.; Ulrickson, M.; Knott, M.J.; Turner, L.R.; Wehrle, R.B. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Argonne National Lab., IL (USA)). Dec 1984. Contract AC02-76CH03073. 102p. (ANL/FPP—84-3). NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85005095.

A series of experiments was successfully conducted to investigate the coupling between induced currents and rigid body rotation in square loops and plates. The experiments were performed with the Fusion Electromagnetic Induction Experiment (FELIX) facility at the Argonne National Laboratory. The observed data exhibited the magnetic damping and magnetic stiffness effects ehich arise in coupled systems and agreed very well with previous analytic calculations.

10659 Taming the world's greatest tokamak. Kaplan, G. (IEEE Spectrum). *IEEE (Institute of Electrical and Electronics Engineers) Spectrum;* **21**: No. 9, 64-69(Sep 1984).

This article reports on research being conducted on the Tokamak Fusion Test Reactor (TFTR) in Princeton, NJ. The first objective of the DOE-funded TFTR is to demonstrate by 1986 that nuclear fusion reactions in hot plasma can release energy equal to that needed to heat plasma (energy break-even). After achieving break-even, the goals will be the operation of an ignited plasma core in a tokamak reactor and the demonstration of the extraction of thermal power from an experimental tokamak reactor. Topics considered include energizing coils by precisely timed currents, gigawatt pulsed power, bidirectional energy flow, the huge tetrode, plasma diagnostics, and data processing. It is shown how power engineering, magnetics, instrumentation, data acquisition, data processing, computers, and computer graphics are being combined to probe, test, measure and analyze the world's most advanced operating fusion reactor.

10660 Gas fueling studies in the PDX tokamak. Pt. 2. Dylla, H.F.; Bell, M.G.; Fonck, R.J.; Jaehnig, K.P.; Kaye, S.M.; Owens, D.K.; Heifetz, D.B.; Schmidt, G.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **121**: 144-150(May 1984). (CONF-830795—).

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Also published as report PPPL–2057; CONF-830795–9.

Measurements of the gas fueling characteristics of the PDX tokamak have been extended in parameter range. An earlier study presented the gas fueling efficiency for H_2 and D_2 for the standard PDX divertor configurations with a large conductance between the divertor and main plasma chambers. This study presents the observed variations in H_2, D_2 and He neutral pressure and ionization light emission for divertor configurations with a restricted conductance between the divertor and main plasma chambers. The restricted conductance improved the divertor/main-chamber compression ratio by more than an order of magnitude. For the sample plasma density, gas fueling from the divertor chamber was twice as efficient as fueling from the main chamber. At the highest plasma densities that were investigated, anti nsub(e) approx.= 4 x 10^{13} cm^{-3}, a decrease in the plasma temperature in the divertor was indicated by a decrease in the ionization light at the divertor throat for D_2 and He fueled discharges. These observations are consistent with a Monte-Carlo model of neutral gas transport in the divertor.

10661 Analytic one-dimensional divertor model with neutral sources. Post, D.E.; Langer, W.D.; Petravic, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **121**: 171-177(May 1984). (CONF-830795—). Contract AC02-76CH03073.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Divertor operation with high-density, low-temperature plasmas near the neutralizer plate offers the possibility of impurity control for high-power, long-pulse fusion experiments. Such plasmas can be produced by intense neutral recycling near the neutralizer plate. To complement large scale computational modeling of such divertors, we have developed a simple analytic model to describe

this divertor regime. Continuity equations for neutral atom and plasma transport are analytically solved in a one-dimensional model, and the role of recycling is examined. The results are parametrized in a dimensionless form and compared with both theoretical and experimental results.

10662 **Modelling of the ASDEX scrape-off and divertor.** Schneider, W.; Lackner, K.; Neuhauser, J.; Rauh, K.G. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)); Heifetz, D.B.; Post, D.E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **121**: 178-183(May 1984). (CONF-830795—).

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

For the divertor configurations of ASDEX a two-fluid model describing the plasma flow and energy transport in the scrape-off layer together with models for the neutral particle dynamics in the divertor chamber have been used to study the relation between the neutral molecule density and plasma density in the divertor and the scrape-off density at the midplane. Results of DEGAS Monte Carlo calculations prove the divertor entrance slits to be nearly impenetrable for neutrals in the presence of a plasma. A global recycling picture is suggested relying on edge density control by the divertor and a hydrogen ion inward drift in the main discharge region to maintain the bulk plasma density even in the absence of neutrals in the main chamber.

10663 **Modelling of dense and cold divertor plasma in D-III.** Shimada, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki; GA Technologies, Inc., San Diego, CA (USA)). *Journal of Nuclear Materials;* **121**: 184-188(May 1984). (CONF-830795—).

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

With single-null poloidal divertor discharges in D-III, very dense and cold (nsub(e) $>= 1 \times 10^{14}$ cm^{-3}, Tsub(e) approx.= 4 eV) divertor plasmas were observed. A numerical code has been developed to understand the mechanisms of the high density divertor. The divertor plasma code solves the equation of continuity, momentum and energy. The particle, momentum and energy source/sink terms are calculated by a neutral code which is solved consistently with the plasma parameters. The radiative cooling by oxygen and particle shielding/recycling at the main plasma scrape-off is also taken into account. The code calculation provides a good fit to the experimentally observed electron temperature, density, particle flux and radiative cooling power.

10664 **Calculations of neutral transport in the PDX divertor.** Heifetz, D.B.; Petravic, M.; Post, D.E.; Lieberson-Heifetz, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **121**: 189-193(May 1984). (CONF-830795—). Contract AC02-76CH03073.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Neutral particle transport during a typical beam-heated PDX diverted discharge was modeled using the multi-dimensional code DEGAS. Plasma parameters were taken from probe measurements, and were assumed not a change during the calculations. A realistic plasma/divertor geometry was included in the model, along with a simple particle recycling scheme. Calculated results were compared with the experimentally measured neutral pressures. Without any pumping in the device, the computed pressures were found to be higher than those measured by a factor of approximately two. Introducing a simple pumping model for wall absorption, wherein 10% of the absorbed neutral particles were assumed not to desorb, reduced the calculated pressures to about the measured values. However the pressure was observed to monotonically increase during the discharge, whereas the model results peaked in mid-discharge. One possible explanation of the disagreement is that the saturation of the device walls increases during the discharge, so that the fraction of particles pumped decreases with time. Reduction of the permanently absorbed fraction from 10 to 4% during the course of the discharge caused the calculated pressure to monotonically increase.

10665 **Determination of the global recombination rate coefficient for the ISX-B tokamak.** Langley, R.A.; Howe, H.C. (Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials;* **121**: 237-242(May 1984). (CONF-830795—). Contract W-7405-ENG-26.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

The global recombination rate coefficient for hydrogen has been measured for the ISX-B tokamak vacuum vessel for various surface conditions. The measurements were performed by observing the rate of decrease of gas pressure in the vessel during a glow discharge. The parameters of the glow discharge and the complete experimental method are described. Previously published analytic and numerical models are used for data analysis. The effects of surface contamination on the results are described. For 'unclean' wall conditions sigmaksub(r) = 1.8×10^{-28} cm⁴/atom x s at 296 K and increases to sigmaksub(r) = 4.4×10^{-26} cm⁴/atoms x s for 'clean' conditions and remains constant until subsequent exposure to air.

10666 **Measurements of the hydrogenic recombination coefficient for the TFTR vacuum vessel.** Dylla, H.F.; Cecchi, J.L.; Knize, R.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **121**: 243-248(May 1984). (CONF-830795—). Contract AC02-76CH03073.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Also published as report PPPL--2046; CONF-830795--7.

Characteristic values of the recombination rate coefficient for hydrogen and deuterium in stainless steel have been measured for the inner wall of the TFTR vacuum vessel for vessel temperatures of 25 - 100°C. In-situ measurements of ksub(r) are important, for predicting the hydrogen isotope rentention in the wall as a function of time, temperature, and discharge exposure, particularly because existing laboratory measurements of ksub(r) for stainless steel span a range of four orders of magnitude. The measurement technique involved the observation of the decrease in hydrogen pressure during a glow discharge in the TFTR vacuum vessel with an initial static gas fill. The resulting values of ksub(r) at 25°C are in the range of (0.4 - 4) x 10^{-27} cm^4 s^{-1} assuming a value of the hydrogenic diffusivity of 2 x 10^{-12} cm^2 s^{-1} at room temperature. No significant isotopic dependence was observed and the temperature dependence of ksub(r) is consistent with the literature value (0.5 eV) of the activation energy. The implications of this range of values of ksub(r), for the estimation of the in-vessel tritium inventory following DT operation in TFTR are discussed.

10667 **Effects of wall conditioning on plasma parameters, impurities and hydrogen recycling in textor.** Clausing, R.E. (Oak Ridge National Lab., TN (USA). Metals and Ceramics Div.); Waelbroeck, F.; Winter, J.; Wienhold, P.; Koenen, L. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik); Noda, N. (Nagoya Univ. (Japan). Inst. of Plasma Physics). *Journal of Nuclear Materials;* **121**: 249-253(May 1984). (CONF-830795—). Contract W-7405-ENG-26.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

A recent series of experiments on TEXTOR offered a unique opportunity to measure the effects of changing wall conditions (surface impurities, temperature, and pretreatment) on plasma parameters, impurities, and hydrogen recycling. The TEXTOR liner is Inconel 625. The liner was baked to 150 or 300°C. It was cleaned by (1) a radio-frequency supported glow discharge (RG) or (2) an electron cyclotron resonant (ECR) plasma. Methane was added to the RG discharge, for one experiment, to increase the carbon concentration and lower the oxygen levels on the wall. Changing wall surface compositions caused the optical light intensities from the major plasma impurities, carbon, and oxygen, to vary by a factor of 2 to 5 and hydrogen recycle coefficients to vary by more than an order of magnitude. Except during dirty wall conditions and during the carbon addition experiments, changes in plasma density and current, electron temperature and energy confinement times were relatively small.

10668 **Mechanical device for enhancing the halo density in the TMX-U tandem mirror.** Hsu, W.L. (Sandia National Labs., Livermore, CA (USA)); Barr, W.L.; Simonen, T.C. (Lawrence Livermore National Lab., CA (USA)). *Journal of Nuclear Materials;* **121**: 264-270(May 1984). (CONF-830795—).

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The halo recycler, a mechanical device similar to pump limiters used in tokamaks, is studied as a means of enhancing the halo plasma density in the Tandem Mirror Experiment Upgrade (TMX-U). The recycler structure consists of an annular chamber at each end of the tandem mirror device where the halo plasma is collected. The halo plasma density is increased by recycling the halo ions as they are neutralized by the collector plate. With sufficient power fed into the halo electrons, the recycler can sustain an upstream electron temperature of 30 eV for effective halo shielding while maintaining a low temperature of 5 eV near the collector plate to reduce sputtering. A power flow model has shown that the required power for heating the halo is low enough to make the halo recycler a practical concept.

10669 **Hot wall experiment in Microtor II.** Keller, L.; Brown, M.L.; Taylor, R.J. (California Univ., Los Angeles (USA). Tokamak Fusion Lab.); Dhir, V.K. (California Univ., Los Angeles (USA). Dept. of Mechanics and Structures); Elliott, J.R.; Williams, R.S. (California Univ., Los Angeles (USA). Dept. of Chemistry and Biochemistry). *Journal of Nuclear Materials;* **121**: 271-276(May 1984). (CONF-830795—).

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Panels made out of 304 SS, Mo, Inconel 600, α-Ti and Ti-6Al-4Mo were installed on the outer walls in Microtor II and heated up to a maximum temperature of 800 °C. No significant Hsub(α)-light emission was observed near the hot panels during tokamak discharges. When carefully outgassed and properly surface conditioned (Ti deposition and discharge cleaning), these hot surfaces do not have a deleterious impact on tokamak discharges. Carbon originating from the bulk materials is the most abundant impurity that accumulates on the hot surfaces. Ti layers at 800°C are able to retain bulk oxygen, but carbon can diffuse out of the substrate materials and through the film to segregate at the Ti-vacuum surface. Inconel 600 substrates released the smallest amount of carbon during discharges. Impurity control with Ti, deposited onto cold panels, remains beneficial even at higher temperatures. Previously observed long term effects such as flaking and peeling are avoided due to interdiffusion of Ti and the panel matrix. Furthermore, hydrogen retention is eliminated.

10670 **Plasma surface interaction experimental facility (PISCES) for materials and edge physics studies.** Goebel, D.M.; Campbell, G.; Conn, R.W. (California Univ., Los Angeles (USA)). *Journal of Nuclear Materials;* **121**: 277-282(May 1984). (CONF-830795—).

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

PISCES is a laboratory research facility at UCLA for the study of plasma material interactions in continuous operation at particle and heat fluxes expected in advanced fusion experiments and in reactors. The PISCES plasma has parameters similar to the edge plasma in tokamaks and the halo plasma in tandem mirrors. The 10 cm diameter plasma is generated by a reflex arc discharge from a large area La-Mo disc cathode. The plasma from this H, D, or He discharge transports along the 2-4 kG magnetic field to produce a high density (10^{13} cm^{-3}), low energy (< 10 eV) plasma. Alternatively, the ions can be extracted and accelerated along the magnetic field by a very low energy acceleration-deceleration system to produce a plasma with 50 - 500 eV ion energy and a density of about 10^{12} cm^{-3}. Differential pumping in the baffled chamber and plasma pumping during operation maintain the neutral pressure at about 10^{-4} Torr in the target region. Initial operation has produced continuous cold hydrogen plasmas for hours at a time with densities in excess of 10^{13} cm^{-3}. The three major foci of PISCES experimental work include: materials and coatings behavior under continuous plasma bombardment to high fluence; plasma and neutral gas effects important in the vicinity of the plasma interface with in-vessel components and the gas ducting and pumping systems; and the development, testing, and calibration of gas ducting and pumping systems; and the development, testing, and calibration of diagnostics to be used in long pulse plasma material interaction programs on confinement experiments. The continuous, controllable operation and moderately high heat fluxes (50 - 125 W/cm^2) possible in PISCES permit high fluence investigations on edge plasma physics and materials interactions. Initial plasma operation, experimental investigations, and the capabilities of PISCES will be discussed.

10671 **Particle removal with pump limiters in ISX-B.** Mioduszewski, P.; Emerson, L.C.; Simpkins, J.E.; Wootton, A.J.; Bush, C.E.; Dunlap, J.L.; Edmonds, P.H.; Gardner, W.L.; Howe, H.C.; Hutchinson, D.P. (Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials;* **121**: 285-293(May 1984). (CONF-830795—). Contract W-7405-ENG-26.

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The first pump limiter experiments were performed on ISX-B. Two pump limiter modules were installed in the top and bottom of one toroidal sector of the tokamak. The modules consist of inertia cooled, TiC-coated graphite heads and Zr-Al getter pumps each with a pumping speed of 1000 - 2000 l/s. The objective of the initial experiments was the demonstration of plasma particle control with pump limiters. The first set of experiments were performed in ohmic discharges (OH) in which the effect of the pump limiters on the plasma density was clearly demonstrated. In discharges characterized by Isub(p) = 110 kA, Bsub(T) = 15 kG, anti nsub(e) = 1 - 5 x 10^{13} cm^{-3} and t = 0.3 s, the pressure rise in the pump limiters was typically 2 mTorr with the pumps off and 0.7 mTorr after activating the pumps. When the pumps were activated, the line-average plasma density decreased by up to a factor 2 at identical gas flow rates. The second set of measurements were performed in neutral beam heated discharges (NBI) with injected powers between 0.6 MW and 1.0 MW. Due to a cooling problem on one of the Zr-Al pumps, the NBI experiments were carried out with one limiter only. The maximum pressure observed in NBI-discharges was 5 mTorr without activating the pumps, i.e., approximately twice as high as in OH-discharges. The exhaust efficiency, which is defined as the removed particle flux divided by the total particle in the scrape-off layer, is estimated to be 5%.

10672 **Initial results from the scoop limiter experiment in PDX.** Budny, R.; Bell, M.G.; Bol, K.; Buchenauer, D.; Cavallo, A.; Crowley, T.; Darrow, D.S.; Dylla, H.F.; Fonck, R.J.; Goldston, R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **121**: 294-303(May 1984). (CONF-830795—). Contract AC02-76CH03073.

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Also published as report PPPL-2061.

A particle scoop limiter with a graphite face backed by a 50 liter volume for collecting particles was used in PDX. Experiments were performed to test its particle control and power handling capabilities with up to 5 MW of D^0 power injected into D$^+$ plasmas. Line average plasma densities of up to 8 x 10^{13} cm^{-3} and currents up to 450 kA were obtained. Plasma densities in the scoop channels greater than 2 x 10^{13} cm^{-3} and neutral densities in the scoop volume greater than 5 x 10^{14} cm^{-3} were observed. There is evidence that recycling may have occurred in the scoop channels for several discharges with large line-averaged plasma density. At beam powers up to 2.5 MW, energy confinement times above 40 ms were deduced from magnetics measurements and from transport analysis. Pressures in the vacuum vessel were in the 10^{-6} Torr range, and recycling source neutral densities in the central plasma were low.

10673 **Advanced Limiter Test-I (ALT-I) variable-geometry pump limiter module.** Pontau, A.E.; Malinowski, M.E.; Ver Berkmoes, A.A.; Guthrie, S.E. (Sandia National Labs., Livermore, CA (USA)); Watson, R.D. (Sandia National Labs., Albuquerque, NM (USA)); Goebel, D.M.; Campbell, G.A. (California Univ., Los Angeles (USA)). *Journal of Nuclear Materials;* **121**: 304-308(May 1984). (CONF-830795—).

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The ALT-I variable geometry module has been designed to address many of the issues not previously settled by earlier experiments. The goal is to study the basic processes involved in pump limiter operation as well as demonstrate its utility and effect on the plasma. The flexibility and extensive instrumentation of ALT-I will offer a unique opportunity to parameterize operation and facilitate the engineering design of future pump limiters.

10674 **Preliminary design analysis of the ALT-II limiter for TEXTOR.** Koski, J.A.; Boyd, R.D.; Kempka, S.M.; Romig, A.D. Jr.; Smith, M.F.; Watson, R.D.; Whitley, J.B. (Sandia National Labs., Albuquerque, NM (USA)); Conn, R.W.; Grotz, S.P. (California Univ., Los Angeles (USA). Dept. of Mechanics and Structures). *Journal of Nuclear Materials;* **121**: 309-315(May 1984). (CONF-830795—). Contract AC04-76DP00789.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Also published as report SAND--83-1654C; CONF-830795--1.

Installation of a large toroidal belt pump limiter, Advanced Limiter Test II (ALT-II), on the TEXTOR tokamak at Juelich, FRG is anticipated for early 1986. This paper discusses the preliminary mechanical design and materials considerations undertaken as part of the feasibility study phase for ALT-II. Since the actively cooled limiter blade is the component in direct contact with the plasma edge, and thus subject to the severe plasma environment, most preliminary design efforts have concentrated on analysis of the blade. The screening process which led to the recommended preliminary design consisting of a dispersion strenghthened copper or OFHC copper cover plate over an austenitic stainless steel base plate is discussed. A 1 to 3 mm thick low atomic number coating consisting of a graded plasma-sprayed Silicon Carbide-Aluminium composite is recommended subject to further experiment and evaluation. Thermal-hydraulic and stress analyses of the limiter blade are also discussed.

10675 **Neutral transport in the ALT-I limiter.** Boley, C.D.; Heifetz, D.B.; Post, D.E. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Malinowski, M.E. (Sandia National Labs., Livermore, CA (USA)). *Journal of Nuclear Materials;* **121**: 316-321(May 1984). (CONF-830795—). Contract AC02-76CH03073.

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The behavior of neutral atoms and molecules in the TEXTOR pump limiter ALT-I has been investigated with the aid of the 2-D Monte Carlo neutral transport code DEGAS. The code incorporates the full set of relevant collision processes (atomic and molecular), and it has a standard wall model which includes fast-neutral reflection and molecular desorption. The limiter has a narrow neck positioned in the toroidal direction, with an entrance at one end and a neutralizer plate set at an angle at the other end. Neutrals born at the neutralizer plate can make their way down a long, narrow duct into a pumping plenum. Both the width of the entrance duct and the width of the duct leading into the plenum can be varied in the experiment. The limiter was modeled with a 2-D geometry, which included corrections for 3-D effects. Among the quantities predicted by the code which are directly relevant to experiment are the neutral pressure within the plenum and along the duct leading into the plenum, the gettering rates, and the heat flux to the walls of the duct. These have been calculated for a variety of plasma parameters in the inlet, and the behavior with respect to variations of the duct widths has been studied. Because of the presence of the long duct separating the entrance chamber from the plenum, a high probability of ionization generally results, suggesting that a calculation allowing the plasma to adjust to the neutral sources might show a large amount of recycling.

10676 **Power flow in neutral beam-heated limiter discharges in the D-III tokamak.** Petrie, T.W.; Armentrout, C.; Burrell, K.H.; Hino, T.; Kahn, C.L.; Kim, J.; Lohr, J.; Schissel, D.P. (GA Technologies, Inc., San Diego, CA (USA)). *Journal of Nuclear Materials;* **121**: 322-328(May 1984). (CONF-830795—). Contract AT03-76ET51011.

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Bolometric, thermocouple, Langmuir probe and infrared camera data are used to deduce the power flow in neutral beam-heated (Psub(input) <= 5 MW), dee-shaped, limiter discharges. Power loss measurements typically account for <= 60% of the total input power, with the majority either deposited on the primary limiter (20 - 40%) or radiated away (10 - 25%). Infrared camera measurements indicate that the heat flux to the ion drift side of the primary limiter is significantly greater than that to the electron drift side. Charge exchange neutral analysis, diamagnetic loop data and photodiode observations are consistent with a non-thermal flux of fast, beam produced particles to the limiter. If such an effect is indeed present, it could be partially responsible for the degradation in energy confinement observed during beam heating. Analysis of data comparing neutral beam injection from the two beamlines indicates that there is a variance in the energy confinement time which is beamline specific; this variance may be correlated to the limiter location relative to the beamlines.

10677 **Major disruption characteristics with a toroidal limiter in PDX.** McGuire, K.; Buchenauer, D.; Izzo, R.; Monticello, D.; Sauthoff, N.; Kawahata, K.; Okano, K. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Couture, P. (Hydro-Quebec, Varennes (Canada). Inst. of Research). *Journal of Nuclear Materials;* **121**: 329-336(May 1984). (CONF-830795—). Contract AC02-76CH03073.

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The PDX tokamak provides an experimental facility for the comparison of a variety of limiter configurations. A large data base of disruption characteristics has been obtained during operation with (a) an inner wall toroidal limiter with its limiting surface at 85 cm, giving a = 40 cm for R = 125 cm, (b) top and bottom carbon rail limiter giving R = 143 cm, a = 40 cm, and (c) an outboard scoop limiter giving R = 153 cm, a = 40 cm. The results show that the average current decay rate $\Delta I/\Delta T$ (kA/ms) for disruptions on the inner wall limiter is about four times faster than for those on the rail or scoop limiters. In addition, the achievement of discharges with qpsi less than 3 (qpsi is the equilibrium safety factor caculated by a MHD code) with the inner wall toroidal limiter is extremely difficult, due to the rapid growth of an m = 3, n = 1 mode as q approaches three. However, the disruption is often triggered by the growth of an m = 2, n = 1 mode after the m = 3, n = 1 mode has saturated in amplitude. The transport phase of the disruption phenomena has the same time scale regardless of limiter configuration. Numerical calculations of resistive MHD stability have been used to explain some of these disruption characteristics.

10678 **Heat flux to the limiter during disruptions and neutral beam injection in Doublet-III.** Hino, T.; DeGrassie, J.; Taylor, T.S.; Hopkins, G.; Meyer, C.; Petrie, T.W.; Kahn, C.L.; Ejima, S. (GA Technologies, Inc., San Diego, CA (USA)). *Journal of Nuclear Materials;* **121**: 337-343(May 1984). (CONF-830795—).

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

The heat flux to the Doublet-III primary limiter has been monitored during plasma disruptions and during neutral beam injection. The surface temperature of the movable TiC-coated graphite limiter was measured with an Inframetrics thermal imaging system and a suitably filtered silicon photodiode spot detector. In addition, the floating electric potential of the limiter with respect to the vacuum vessel was measured. The heat pulse duration to the limiter was measured by the spot detector with a time response of x approx.= 10 μs and these times were correlated with the plasma parameters. In limiter discharges, 20% of the plasma kinetic stored energy goes to the limiter during disruptions. The power balance during disruptions is also discussed. During neutral beam injection,

the limiter is not heated uniformly; the ion drift side receives much more thermal flux than the electron drift side. The fraction of beam power going to the limiter is as high as approx.= 35% in normal limiter discharges.

10679 **Conditioning and power-handling of the cooled graphite limiter on PDX.** Owens, D.K.; Fonck, R.J.; Darrow, D.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **121**: 344-349(May 1984). (CONF-830795—). Contract AC02-76CH03073.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

A single graphite rail limiter was used for high power neutral beam injection experiments on PDX from February to July, 1982. The uncoated water-cooled limiter, with a total area of 800 cm^2, performed well in discharges of up to 7 MW of injected power. It was initially conditioned with high power ohmic discharges which removed absorbed and adsorbed impurities. After conditioning, carbon was the primary impurity which evolved from the limiter during high power neutral beam heated discharges. Visible Bremsstrahlung measurements of Zsub(eff) were employed to determine the effectiveness of the limiter in maintaining clean plasmas during neutral beam heating and as a measure of the conditioning of the limiter with time. Operation for a period of several months was required to condition the limiter surface to the point where neutral beam injection of 7 MW for 250 ms resulted in only a small rise in Zsub(eff). Thermocouple measurements and a nonlinear cooling model were used to estimate both the absorbed power and the corresponding surface temperatures of the limiter. For the series of discharges studied, the power absorbed by the limiter was found to increase with input power at lower plasma currents, but was almost constant at large plasma current and beam power.

10680 **Advanced pump limiter experiment of large toroidal extent - ALT II.** Conn, R.W.; Goebel, D.M.; Grotz, S.P.; Prinja, A.K.; Schafer, R.F. (California Univ., Los Angeles (USA). School of Engineering and Applied Science); Heifetz, D.B. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Gauster, W.B.; Koski, J.A. (Sandia National Labs., Albuquerque, NM (USA)). *Journal of Nuclear Materials;* **121**: 350-360(May 1984). (CONF-830795—).

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

Concepts for an advanced pump limiter experiment able to exhaust 5-10% of the plasma particle flux and remove 200 W/cm^2 of heat flux on the limiter face are developed and analyzed. An axisymmetric toroidal belt limiter has a compound curvature blade with edges that extend one particle e-folding distance into the scrape-off layer plasma. Approximately 30% of the plasma efflux flows in a gap between the bottom of the limiter blade and the top of either a structural floor, a plenum box or a liner. Neutralizer/deflector plates are located in discrete pairs at each pumping duct and are designed to optimally scatter neutralized particles into the pump ducts. An alternative design consists of a central toroidal spine beneath the blade which scatters plasma as neutral gas into a plenum box. For application to the TEXTOR tokamak with 1.5 MW of ICRF heating and 2,6 MW of 50 keV neutral beam injection, detailed analysis shows that an average heat flux is approximately 200 W/cm^2 and that the localized collector plate design is about five times more efficient than the spinal design for particle removal.

10681 **Preliminary results from the ergodic magnetic limiter experiment on the TEXT experimental tokamak.** Ohyabu, N.; DeGrassie, J.S.; Brooks, N.H.; Taylor, T.S.; Ikezi, H. (GA Technologies, Inc., San Diego, CA (USA)). *Journal of Nuclear Materials;* **121**: 363-367(May 1984). (CONF-830795—). Contract AT03-76ET51011.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

The first experimental test of the ergodic magnetic limiter concept is being conducted on the TEXT device. Modular coils have been installed on TEXT allowing the external generation of resonant helical field perturbations. Preliminary results are presented.

10682 **Self-pumping impurity control by in-situ metal deposition.** Brooks, J.N.; Mattas, R.F. (Argonne National Lab., IL (USA). Fusion Power Program). *Journal of Nuclear Materials;* **121**: 392-397(May 1984). (CONF-830795—).

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A system for in-situ removal of helium by trapping in freshly deposited metal surface layers of a limiter of divertor has been studied. The system would trap helium on a limiter front surface or a divertor plate, at low plasma edge temperatures, or in a limiter slot region at high edge temperatures. Fresh material introduced to the plasma and/or scrape-off zone, would be added at a rate of about five times the alpha production rate. The material would be reprocessed periodically, e.g., once a year. Possible materials are nickel, vanadium, niobium, and tantalum. Advantages of a self-pumping system are the absence of vacuum ducts and pumps, and the minimization of tritium processing and inventory.

10683 **Modification of alloy surface composition by segregation processes as a means of impurity control in fusion devices.** Krauss, A.R.; Gruen, D.M. (Argonne National Lab., IL (USA). Chemistry Div.); DeWald, A.B. (Georgia Inst. of Tech., Atlanta (USA). Nuclear Engineering Dept.). *Journal of Nuclear Materials;* **121**: 398-403(May 1984). (CONF-830795—). Contract W-31-109-ENG-38.

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The bulk properties required of materials to be used in fusion devices: tensile strength, swelling resistance, thermal conductivity, low induced activity, and high melting point, are not generally compatible with the required surface properties of low Z and low chemical reactivity with hydrogen. Coatings have been suggested as a means of providing the necessary surface properties, while preserving the requisite substrate properties. The coatings, however, introduce new problems in terms of maintenance, thermal conductivity and mechanical integrity. We are investigating the use of surface segregation in alloys as a means of producing low Z coatings which are self-sustaining in a reactor environment, present no thermal barrier to the substrate, and avoid mechanical problems associated with the interface region. Several candidate materials have emerged from our calculations, including alloys of copper, vanadium and tungsten. The segregation calculations, light and heavy ion sputtering properties and thermodynamic properties of these materials are presented. Calculations indicate that as little as one atomic layer of low Z material significantly reduces the substrate erosion for both light and heavy ion sputtering. Experimental data on the degree of surface segregation and the rate at which the low Z component migrates to the surface are presented using dilute alloys of lithium in copper as a reference system. The long term stability of the overlayer is limited primarily by the rate at which radiation-enhanced diffusion can replace the eroded surface material. The radiation-enhanced process proceeds much more quickly than the purely thermodynamic process and depends on the damage profile, which in turn depends on the mass and energy spectrum of the incident radiation.

10684 **DCT-8 pumped limiter design considerations.** Fuller, G.M.; Cramer, B.A.; Haines, J.R. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA); Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials;* **121**: 435-440(May 1984). (CONF-830795—). Contract W-7405-ENG-26.

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Disruption erosion drives the life of the DCT-8 pumped limiter. This result came from an evaluation of beryllium (Be), beryllium oxide (BeO), and silicon carbide (SiC) as candidate surface tile materials. Beryllium oxide was selected as the reference tile material because it has the longest life: 13 full power hours (2300 burns a 20 s/burn) or 2.3 years of DCT-8 operation. The fabricability of any of the candidate materials and the ability to survive thermal shock conditions and electromagnetic loads imposed by disruptions are serious concerns. The most desirable materials from an engi-

neering standpoint (graphite and high-Z, e.g., tantalum) were eliminated due to physics considerations.

10685 **Alcator DCT: Heat removal and impurity control in a proposed long pulse tokamak.** Lipschultz, B.; Montgomery, D.B.; Politzer, P.A.; Wolfe, S.M. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). *Journal of Nuclear Materials;* **121**: 441-448(May 1984). (CONF-830795—). Contract AC02-78ET51013.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

The most crucial requirement for any heat removal and impurity control system is its performance under steady state reactor level loading. The proposed Alcator DCT device at MIT will provide a near term test of long pulse and steady state issues integral to the tokamak program. The objectives of the proposed machine are the development of plasma edge, impurity, shape and profile control techniques appropriate to steady state high power operation; the optimization of RF current drive and heating techniques; and the demonstration of an integrated fully superconducting PF and TF magnet system. This paper gives a description of the physical machine and a review of achievable parameters. Three impurity control designs that are contemplated are described and compared.

10686 **Thermal loads on the ignitor limiter for elongated plasmas.** Cecchi, J.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Coppi, B. (Massachusetts Inst. of Tech., Cambridge (USA)). *Journal of Nuclear Materials;* **121**: 449-452(May 1984). (CONF-830795—). Contract AC02-76CH03073.

From Symposium on energy removal and particle control and toroidal fusion devices; Princeton, NJ, USA (26 Jul 1983).

We present an analysis of the energy flux to the axisymmetric limiter in Ignitor for plasmas with elongation K from 1.0 to 1.32 and midplane scrape off distances lambda from 0.5 cm to 3.0 cm. We find that the elongation for a given scrape-off distance is limited by the allowable limiter edge heat load. We also find that by varying the elongation as a function of scrape-off distance, we can limit the peak energy flux to approximately 300 W/cm^2 for 0.5 cm <= lambda <= 3.0 cm, assuming 4.5 MW total power incident on the limiter.

10687 **(UCRL-Trans—12023) Model of a thermoreactor based on an adiabatic trap with MHD stabilizers.** Dimov, G.I. (Lawrence Livermore National Lab., CA (USA); AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1984. Contract W-7405-ENG-48. Translation source information not available . 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004416.

The model of a thermonuclear reactor (MTR) is intended for production and study of a deuterium-tritium plasma with thermonuclear parameters and to solve the basic engineering and technological problems connected with a thermonuclear reactor based on an ambipolar trap.

10688 **Overview of the HYFIRE power/electrolysis reactor design.** Fillo, J.A.; Powell, J.R. (Brookhaven National Lab., DNE, Upton, NY 11973). *Nuclear Technology/Fusion;* **4**: No. 2, 184-188(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The HYFIRE studies have investigated a number of technical approaches for using the thermal energy produced in a high-temperature Tokamak blanket to provide the electrical and thermal energy required to drive a high-temperature (>1000°C) water electyrolysis process. Current emphasis has been on two design points, one consistent with a peak electrolyzer temperature of about 1300°C (based on current laboratory experience with high-temperature, solid electrolyte fuel cells), and a second, consistent with a peak electrolyzer temperature of about 1300°C, which is an extrapolation of present experience. The technical integration of fusion and high-temperature electrolysis appears feasible.

10689 **Relative public health effects from accidental release of fusion structural radioactivity.** Piet, S.J.; Kazimi, M.S. (EG and G, Inc./Fusion Safety, P.O. Box 1625, Idaho Falls, ID 83415). *Nuclear Technology/Fusion;* **4**: No. 2, 533-538(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The FUSECRAC code, a modification of the CRAC code, was developed to estimate public health effects from released fusion radioactivity both for safety studies and for comparison of the hazards associated with candidate structural materials. This paper summarizes the key motivations, problems, and results of the FUSECRAC comparison. The evolving CRAC code is a product of the Reactor Safety Study and represents the state of the art in fission accident consequence assessments. It was found that potential public health effects from accidental releases of 316 SS are two orders of magnitude higher than from V-15Cr-5Ti or TZM per unit volume of activated first wall released. The probabilities for releases among these materials were not addressed here.

10690 **Control for fusion thermal stability.** Maya, I.; Campbell, H.D. (GA Technologies Inc., P.O. Box 85608, San Diego, CA 92138). *Nuclear Technology/Fusion;* **4**: No. 2, 135-140(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

An analysis of the thermal balance of a fusioning plasma from a control system perspective has been performed. The requirements for stability and the response characteristics of the thermal balance have been evaluated. The results show that open-loop equilibria are characterized by restrictively narrow stable operating temperature regimes and generally poor system performance. Closed-loop proportional feedback using the fuel feedrate and injection energy can be used to extend the stable operating temperature regime and significantly improve the system response. Thus, high open-loop temperature overshoots without neutral beam injection can be reduced to acceptable levels at temperature overshoots without neutral beam injection can be reduced to acceptable levels at temperatures as low as 20 keV, with a decrease in the settling time to under 30 sec. With 75 keV injection energy, acceptable overshoot can be obtained at plasma temperatures as low as 10 keV, with the time-to-peak below 20 sec and settling times less than 30 sec. It is still difficult to simultaneously satisfy overshoot and speed of response requirements at low temperatures with low feedback fractions. Additional improvement is available using proportional-integral-derivative (PID) control.

10691 **Overview of MFAC panel on tandem mirrors and tokamaks.** Gilleland, J.R. (GA Technologies Inc., P.O. Box 85608, San Diego, CA 92138). *Nuclear Technology/Fusion;* **4**: 31-35(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

In the spring of 1982, the Magnetic Fusion Advisory Committee (MFAC) was formed by the Secretary of Energy to advise the Department on fusion research and development. In response to specific requests from the Director of Energy Research, the Committee is formulating findings and recommendations on several key issues. Charges to special study groups include formulation of an integrated tokamak and tandem mirror research plan, an overall review of alternate concept development, analysis of possible upgrades of TFTR and MFTF-B, and a close look at the best roles for universities, industry, and national laboratories in fusion development. This paper attempts to summarize the findings and recommendations of the MFAC Review Panel on Tokamaks and Tandem Mirrors. The panel was charged with: (1) making an assessment of the existing technical data base for tokamak and mirror reactor development, (2) conducting a comparative analysis of reactor prospects, and (3) formulating an integrated development plan for various specified budget assumptions. The main goal of the tokamak and mirror programs is the production of a high-pressure, high-temperature plasma of sufficiently high Q, where Q is defined as the ratio of fusion power output to plasma heating input power. The value of Q must be high enough to keep the cost of recirculating power acceptable relative to other plant costs. The reactor parameters required to meet this condition for sample designs are shown.

10692 **Fusion breeder reactor design studies.** Moir, R.W.; Lee, J.D. (Lawrence Livermore National Lab., P.O. Box 5511, L-644, Livermore, CA 94550). *Nuclear Technology/Fusion;* 4: No. 2, 589-598(Sep 1983). (CONF-830406—).

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Studies of the technical and economic feasibility of producing fissile fuel in tandem mirrors and in tokamaks for use in fission reactors are presented. Fission-suppressed fusion breeders promise unusually good safety features and can provide make-up fuel for 11 to 18 LWRs of equal nuclear power depending on the fuel cycle. The increased revenues from sales of both electricity and fissile material might allow the commercial application of fusion technology significantly earlier than would be possible with electricity production from fusion alone. Fast-fission designs might allow a fusion reactor with a smaller fusion power and a lower Q value to be economical and thus make this application of fusion even earlier. A demonstration reactor with a fusion power of 400 MW could produce 600 kg of fissile material per year at a capacity factor of 50%. The critical issues, for which small scale experiments are either being carried out or planned, are: 1) material compatibility, 2) beryllium feasibility, 3) MHD effects, and 4) pyrochemical reprocessing.

10693 **Exploratory reactor physics studies of negative tandem mirror fusion reactors.** Zawaideh, E.; Kantrowitz, F. (Fusion Engineering and Physics Program, School of Engineering and Applied Science, Univ. of California at Los Angeles, CA 90024). *Nuclear Technology/Fusion;* 4: No. 2, 1320-1325(Sep 1983). (CONF-830406—).

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A physical model of plasma behavior in a negative tandem mirror reactor (NTMR) is used to explore the potential of this configuration as a reactor utilizing the deuterium-deuterium (DD) fuel cycle. It is found that relatively high values of plasma Q, in the range 15 to 20, may be possible in an NTMR if passive pumping of deeply trapped ions in the end cell is possible. Further, synchrotron radiation and hot electron end losses are dominant and require accurate modelling. If the physics elements of the model are verified by experimental findings, the results show negative tandem mirrors to be superior to their positive mode counterparts for DD burning.

10694 **A comparison of fusion breeder/fission client and fission breeder/fission client systems for electrical energy production.** Land, R.J.; Parish, T.A. (Nuclear Engineering Dept., Texas A and M Univ., College Station, TX 77843). *Nuclear Technology/Fusion;* 4: No. 2, 155-160(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A parametric study that evaluated the economic performance of breeder/client systems is described. The linkage of the breeders to the clients was modelled using the stockpile approach to determine the system doubling time. Since the actual capital costs of the breeders are uncertain, a precise prediction of the cost of a breeder was not attempted. Instead, the breakeven capital cost of a breeder relative to the capital cost of a client reactor was established by equating the cost of electricity from the breeder/client system to the cost of a system consisting of clients alone. Specific results are presented for two breeder/client systems. The first consisted of an LMFBR with LWR clients. The second consisted of a DT fusion reactor (with a ^{238}U fission suppressed blanket) with LWR clients. The economics of each system was studied as a function of the cost of fissile fuel from a conventional source. Generally, the LMFBR/LWR system achieved relatively small breakeven capital cost ratios; the maximum ratio computed was 2.2 (achieved at approximately triple current conventional fissile material cost). The DTFR/LWR system attained a maximum breakeven capital cost ratio of 4.5 (achieved at the highest plasma quality (ignited device) and triple conventional fissile cost).

10695 **FED-R: A fusion engineering device utilizing resistive magnets.** Jassby, D.L.; Kalsi, S.S. (Princeton Plasma Physics Lab., Princeton, NJ 08544). *Nuclear Technology/Fusion;* 4: No. 2, 1052-1057(Sep 1983). (CONF-830406—).

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The principal purpose of the FED-R tokamak facility is to provide a substantial quasisteady flux of fusion neutrons irradiating a large test area in order to carry out thermal, neutronic and radiation effects testing of experimental blanket assemblies. The emphasis on reliable nuclear testing capability demands that the plasma physics characteristics and technological features of the fusion machine be chosen as close to mid-1980s' state of the art as possible, with the important exception that FED-R requires high-duty-factor operation. The outboard nuclear test region is at least 80 cm deep with approximately 60 m^2 of exposure area. The neutron wall loading is 0.4 MW/m^2 in Stage I operation (Q /SUB p/ =1.5) and 1.3 MW/m^2 in Stage II (Q /SUB p/ =2.5). The toroidal field coils are fabricated of water-cooled copper plates with demountable joints and operate steady state with a power dissipation of 180 MW in Stage I and 280 MW in Stage II.

10696 **Engineering testing requirements in FED/INTOR.** Abdou, M.A.; Nygren, R.E. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL 60439). *Nuclear Technology/Fusion;* 4: No. 2, 1043-1051(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The FED/INTOR Critical Issues activity examined three key testing requirements that have the largest impact on the design, operation and cost of FED/INTOR. These are: 1) the total testing time (fluence) during the device lifetime, 2) the minimum number of back-to-back cycles, and 3) the neutron wall load. These requirements were quantified by investigating the benefits/risks to the DEMO from testing structural materials, blankets, and main reactor components in FED/INTOR.

10697 **Alternative technological pathways for tokamak fusion.** Gibson, G.; Sink, D.A. (Westinghouse Electric Corp., Advanced Energy Systems Div., Madison, PA 15663). *Nuclear Technology/Fusion;* 4: No. 2, 1037-1042(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Three pathways to commercial fusion based on a tokamak driver have been developed and analyzed. These pathways are identified as 1) the fusion electric, 2) the fusion-fission hybrid, and 3) the integrated electric hybrid pathways. The analyses of the various pathways show significant differences in technology requirements. In developing these pathways special emphasis has been placed on the next device in the hybrid pathway which would follow TFTR. As part of this study a first version of the Fusion Technology Capabilities Compendium has been assembled. The compendium includes the driver, blanket, and fuel cycle technologies and it provided background information which has been used to identify critical R&D needs for a 1990's hybrid device.

10698 **Desirable engineering features of the next generation tokamak device.** Brown, T.G.; Flanagan, C.A. (Fusion Engineering Design Center/Grumman Aerospace Corp., P.O. Box Y, FEDC Building, Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 1031-1036(Sep 1983). (CONF-830406—).

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The early tokamak reactor configuration was developed as a means to identify engineering and technology problems and, if possible, suggest resolutions. The power reactor was depicted as a large device with many superconducting toroidal field (TF) coils and many distributed internal and external poloidal field (PF) coils. The mechanical configuration dictated a complicated maintenance approach. Access to the plasma chamber was limited. Particular attention has been paid, in recent reactor studies, [1-3] to incorporate attractive, cost-effective engineering features to minimize the device complexity and satisfy the assembly and maintenance requirements of the various reactor components. This has been accomplished without degrading the physics operating parameters of the reactor. In the design process, a number of desirable engineering features have been identified that, when incorporated, make the tokamak a much more attractive reactor candidate. Recent scoping studies ex-

amined a series of superconducting, long-pulse Driven Current Tokamak (DCT) devices. One class of options is an ignited, D-T burning device designated DCT-8. It was concluded that the DCT-8 is a most attractive engineering option to adequately bridge the gap between the Tokamak Fusion Test Reactor (TFTR) and the Engineering Test Reactor (ETR).

10699 **Driven current tokamak (DCT) scoping study.** Reid, R.L. (FEDC/ORNL, P.O. Box Y, Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 1025-1030(Sep 1983). (CONF-830406—).

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The present Department of Energy (DOE) plan calls for the construction of an Engineering Test Reactor (ETR) that is to be the last major experimental fusion device prior to the commercialization of fusion power. The plasma driver of the ETR is to be either a long-pulse tokamak or a tandem mirror machine. The possibility of using the Tokamak Fusion Test Reactor (TFTR) facility to consolidate the physics and technology database for the tokamak version of the ETR has been considered. This paper addresses two of the options being considered: (1) a superconducting toroidal field (TF) coil-hydrogen plasma alternative and (2) a superconducting or hybrid TF coilhigh Q alternative. Both options assume essentially steady-state operation through the application of rf current drive. The options are evaluated on the basis of performance and cost determined by application of the Fusion Engineering Design Center (FEDC) Tokamak System Code.

10700 **Design of the Alcator DCT tokamak at M.I.T.** Schultz, J.H.; Montgomery, D.B. (Plasma Fusion Center, Massachusetts Inst. of Technology, Cambridge, MA 02139). *Nuclear Technology/Fusion;* 4: No. 2, 1019-1024(Sep 1983). (CONF-830406—).

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Alcator DCT is an experimental tokamak proposed to be built at M.I.T. It features extremely long pulses, RF heating and current drive, and an all superconducting magnet system. The toroidal magnets produce a field on-axis of 7 T, permitting current drive at high density and ion heating with existing power supplies. The device is designed to maximize the use of existing facilities at M.I.T. in order to build a machine large enough for simultaneous heating and current drive at low cost. This report concentrates on a design option with 24 circular toroidal field (TF) magnets, which represents the second iteration in the conceptual design of this machine. This design is a modification of the HESTER concept developed by the authors. The DCT design is an advance over the HESTER design, in that it has adequate horizontal port space for human access and for tangential viewing of the plasma at the geometric center. This was achieved by decreasing the number of TF coils from 36 to 24, increasing the magnet bore from 52 to 62 cm and shaving diagonals from noncritical areas of the case in the lead and header region. Recent perceptions of the requirements of the tokamak program in the areas of impurity control and in-vessel component screening indicate that a third significant iteration of the DCT concept is necessary. The Alcator DCT uses pumped limiters for long term impurity control. Doubts about the efficacy of pumped limiters and a desire to concentrate on long-term impurity control issues led to the recommendation that DCT be modified to include expanded boundary and simplified poloidal divertor operation. Early work on these options is described briefly.

10701 **Compact fusion reactors.** Krakowski, R.A.; Hafenson, R.L. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). *Nuclear Technology/Fusion;* 4: No. 2, 1265-1274(Sep 1983). (CONF-830406—).

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Compact, high-power-density approaches to fusion power are proposed to improve economic viability through the use of less-advanced technology in systems of considerably reduced scale. The rationale for and the means by which these systems can be achieved are discussed, as are unique technological problems.

10702 **Recent developments in stellarator physics.** Johnson, J.L. (Plasma Physics Lab., Princeton Univ., Princeton, NJ 08544). *Nuclear Technology/Fusion;* 4: No. 2, 1275-1283(Sep 1983). (CONF-830406—).

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Experimental and theoretical work on the stellarator concept has established its position as the best alternate concept for fusion power. Its plasma properties are comparable to, or better than, those obtained in comparable tokamak devices. Confinement and transport should be adequate for reactor operation, with high-β operation possible. Although the coil configurations in present experiments are complicated, stellarator reactors could be simpler than tokamaks. The possibilities of steady-state operation, little recirculating power, good start-up and control properties, no disruptions, modular construction, and a builtin divertor make it an obvious direction for tokamak evolution as well as a viable alternate concept in its own right.

10703 **Engineering design of a compact RFP reactor (CRFPR).** Hagenson, R.L.; Krakowski, R.A. (Technology International, Inc., 2515 Elwood Drive, Ames, IA 50010). *Nuclear Technology/Fusion;* 4: No. 2, 1284-1289(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The results of a previously-reported comprehensive parametric systems analysis of the Reversed-Field Pinch (RFP) were minimum-cost systems that would operate with resistive water-cooled copper coils and higher first-wall neutron current (15-20 MW/m^2). These minimum cost, "compact" RFP reactors (CRFPRs) have system power densities that can be comparable with fission power plants and, therefore, are 10-30 times smaller than most superconducting approaches. Reported herein are initial results of a conceptual engineering design of key fusion-power-core (FPC) subsystems.

10704 **Experience with the modular design concept of the OHTE experimental device during initial assembly, operations, and the mid-experiment upgrade.** Graumann, D.W. (GA Technologies Inc., P.O. Box 85608, San Diego, CA 92138). *Nuclear Technology/Fusion;* 4: No. 2, 1290-1295(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The OHTE experimental device was designed with five distinct modules with the idea of assuring flexibility during initial construction and later maintenance activities. Experience over the last two years has proven the value of this approach in maximizing experimental time. Construction and major upgrade activities were accomplished in shorter times because the work on the various modules was done in parallel. Moreover, the efficiency of these activities was increased because the subassemblies were located at several on-site facilities where additional equipment, work space and personnel were available. Downtimes during minor maintenance activities have been minimized because disassembly and reassembly of the modular machine can be accomplished in a matter of days.

10705 **Design of the Advanced Toroidal Facility (ATF-1).** Johnson, R.L.; Adams, O.B. (UCC-ND, Bldg. 9204-1 US-15, P.O. Box Y, Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 1296-1301(Sep 1983). (CONF-830406—).

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The Advanced Toroidal Facility (ATF-1) is a torsatron being designed at ORNL as a replacement for the ISX-B tokamak. The concept for the device includes two continuous helical field coils and a set of twelve toroidal field coils. The vacuum vessel is placed inside the helical field coils and an external toroidal shell support structure is provided to react all coil and vacuum vessel loads. The present design status for all systems is discussed.

10706 **A Long-pulse Ignited Test Experiment (LITE).** Bromberg, L.; Cohn, D. (M.I.T. Plasma Fusion Center, Cambridge, MA 02139). *Nuclear Technology/Fusion;* 4: No. 2, 1013-1018(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The authors describe a design concept for a tokamak that has the capability of sustained ignited operation and utilizes high performance copper plate magnets to minimize size and cost. They refer to this device as LITE for Long-pulse Ignited Test Experiment. LITE is designed so that it could be located in the TFTR Test Cell, so that substantial cost savings can be realized. Two design options are considered. Illustrative parameters for the lower beta option (LITE-1) are a major radius of 2.7 m, a maximum magnetic field on axis of 8.1 T, and $<\beta> = 0.05$. Steadystate water cooling would be used for nominal DT operation and for very long pulse hydrogen operation. Inertial cooling with liquid nitrogen could be employed for a relatively small number of pulses to provide the highest magnetic fields and ignition margins. The second option (LITE2) makes use of a highly shaped plasma to obtain high beta (>10%) operation. The LITE-2 concept is at a very early stage, so that emphasis in this paper is on the description of LITE-1.

10707 **Progress in fusion technology in the U.S. Magnetic Fusion Program.** Dowling, R.J. (U.S. Dept. of Energy, ER-53, Office of Energy Research, Washington, DC 20545). *Nuclear Technology/Fusion;* 4: No. 2, 20-29(Sep 1983). (CONF-830406—).

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The U.S. Fusion Technology Development Program integrates the diverse technology activities within the Office of Fusion Energy. The program contains essentially all the technology activities, both to support the scientific efforts and to resolve a limited number of critical technology feasibility issues. There has been a significant amount of progress in the last few years in the development of reactor-scale fusion technologies. For example, in the area of gyrotron development for radio frequency (RF) heating, 28 gigahertz (GHz) gyrotrons at 200 kW continuous wave (cw) and 60 GHz gyrotrons at 124 kW cw have been operated. Present plans call for continuing development of 100 GHz gyrotrons at higher power levels. In the magnetics area, construction of the Large Coil Test Facility (LCTF) will be completed and initial operations with two coils should begin in 1983. The other four large coils should be delivered to permit full 6 coil torus testing to begin in 1984. The research and development plans for the Magnetic Fusion Energy Program are contained in the Fusion Technology Development Plan (FTDP) which is being distributed. In order to assure that the activities described in the FTDP are consistent with the overall fusion program strategy and to optimize resource allocation recognizing budget constraints, the Fusion Technology Program has prioritized its activities. This paper will review some of the recent progress and future plans in fusion technology in the U.S. Magnetic Fusion Program.

10708 **Next tokamak facility.** Schmidt, J.A.; Flanagan, C.A. (Princeton Plasma Physics Lab., Princeton Univ., P.O. Box 451, Princeton, NJ 08540). *Nuclear Technology/Fusion;* 4: No. 2, 56-61(Sep 1983). (CONF-830406—).

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Design studies on a superconducting, long-pulse, current-driven, ignited tokamak, called the Toroidal Fusion Core Demonstration (TFCD), are being conducted by the Fusion Engineering Design Center (FEDC) and Princeton Plasma Physics Laboratory (PPPL) with additional broad community involvement. Options include the use of allsuperconducting toroidal field (TF) coils, a superconducting-copper hybrid arrangement of TF coils, or all-copper TF coils. Only the first two options have been considered to date. The general feasibility of these approaches has been established with the goal of high performance (ignition, about390 MW; wall loading about2.2 MW/m^2) at minimum capital cost. The preconceptual effort will be completed in early FY 1984 and a selection made from the indicated options. The TFCD is judged to represent a reasonable necessary step between the Tokamak Fusion Test Reactor (TFTR) and the Engineering Test Reactor (ETR).

10709 **Fusion power demonstration.** Henning, C.D.; Logan, B.G. (Lawrence Livermore National Lab., P.O. Box 5511, L-644, Livermore, CA 94550). *Nuclear Technology/Fusion;* 4: No. 2, 67-72(Sep 1983). (CONF-830406—).

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As a satellite to the MARS (Mirror Advanced Reactor Study) a smaller, near-term device has been scoped, called the FPD (Fusion Power Demonstration). Envisioned as the next logical step toward a power reactor, it would advance the mirror fusion program beyond MFTF-B and provide an intermediate step toward commercial fusion power. Breakeven net electric power capability would be the goal such that no net utility power would be required to sustain the operation. A phased implementation is envisioned, with a deuterium checkout first to verify the plasma systems before significant neutron activation has occurred. Major tritium-related facilities would be installed with the second phase to produce sufficient fusion power to supply the recirculating power to maintain the neutral beams, ECRH, magnets and other auxiliary equipment.

10710 **First plasma operation of TFTR.** Machalek, M.D. (Princeton Plasma Physics Lab., P.O. Box 451, Princeton, NJ 08544). *Nuclear Technology/Fusion;* 4: No. 2, 191-193(Sep 1983). (CONF-830406—).

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First plasma was achieved in the Tokamak Fusion Test Reactor (TFTR) at 3:06 a.m., December 24, 1982. Contributing to the success of achieving first plasma were a number of new procedures, techniques and facilities. These included formal programs of Subsystem Testing and Integrated Systems Testing, a formal First Plasma Operational Readiness Review and a TFTR Operations/Information Center. Because of the magnitude and significance of the TFTR project, the innovations techniques and procedures which proved useful for first plasma will be continued as TFTR proceeds toward its goal of attaining scientific breakeven in fusion in 1986.

10711 **Physics basis for an ignited long-pulse tokamak.** Rutherford, P.H. (Princeton Plasma Physics Lab., P.O. Box 451, Princeton, NJ 08544). *Nuclear Technology/Fusion;* 4: No. 2, 36-45(Sep 1983). (CONF-830406—).

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Recent advances in tokamak research have led to an improved understanding of the plasma requirements for achieving long pulse ignited burn in a tokamak plasma. This paper presents an assessment of these requirements in the areas of plasma energy confinement, plasma stability at high beta-values, plasma heating, particle and impurity control, and non-inductive current drive. In all areas, the physics basis appears adequate to support a near-term demonstration of a fusion reactor core -- a long-pulse ignition experiment -- in a device of acceptable overall size and cost.

10712 **Tokamak ETR objectives, characteristics and critical issues.** Stacey, W.M. Jr. (Georgia Inst. of Technology, Atlanta, GA 30332). *Nuclear Technology/Fusion;* 4: No. 2, 46-55(Sep 1983). (CONF-830406—).

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An initial identification of objectives and physical characteristics of a tokamak engineering test reactor is made, based upon the large body of work that has been devoted to the study of such devices over the past decade. The critical technical issues affecting the feasibility and the specification of design concept for a tokamak engineering test reactor are discussed.

10713 **The TFTR Lithium Blanket Module final design and materials development.** Graumann, D.W.; Creedon, R.L. (P.O. Box 85608, San Diego, CA 92138). *Nuclear Technology/Fusion;* 4: No. 2, 1222-1227(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A Lithium Blanket Module (LBM) representative of a fusion reactor blanket module has been designed and will be tested using the toroidal neutron source of the Tokamak Fusion Test Reactor

(TFTR) beginning in 1985. A rugged design consisting of 921 2.54 cm diameter breeder rods in an 80 cm cubic box has been developed, and the techniques and equipment necessary for mass production of the Li_2O breeder pellets have been demonstrated. Analysis using a coupled Monte Carlo neutronics model has shown that tritium production is uniform across the module to within 8 cm of the edge, and that the front face fusion fluence and central region tritium production can be calculated to acceptable accuracies for eventual comparison with measurements on the LBM installed on the TFTR.

10714 **Central cell blanket module maintenance approach for the MARS high temperature blanket.** Young, N.E.; Sutliff, D. (Ebasco Services Inc., Princeton, NJ 08544). *Nuclear Technology/Fusion;* 4: No. 2, 234-238(Sep 1983). (CONF-830406—).

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The Mirror Advanced Reactor Study (Mars) considers two blanket designs: A high temperature helium (1000°C) and lead lithium cooled blanket for synthetic fuels production as well as a simplier lead lithium cooled blanket for electrical power production. These blankets employ fundamentally different maintenance concepts for yearly replacement. A method for replacing this synfuel blanket has been developed and time of removal estimated. Methods for blanket disassembly and preparation for off-site shipment have also been developed and are presented.

10715 **Key issues of FED/INTOR impurity control system.** Abdou, M.A. (Argonne National Lab., 9700 South Cass Ave., Argonne, IL 60439). *Nuclear Technology/Fusion;* 4: No. 2, 654-665(Sep 1983). (CONF-830406—).

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A key part of the recent FED/INTOR activity was focused on examining the critical issues and developing credible physics and engineering solutions for the impurity control system. The work emphasized the edge-region physics, plasma-wall interaction, materials, engineering, and magnetic considerations of the poloidal divertor and pump limiter. This paper summarizes the key results.

10716 **The TRIO-01 experiment.** Clemmer, R.G.; Malecha, R.F. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439). *Nuclear Technology/Fusion;* 4: No. 2, 83-92(Sep 1983). (CONF-830406—).

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The TRIO-01 experiment is a comprehensive test of in-situ tritium recovery from a miniaturized solid breeder blanket assembly. Other solid breeder blanket performance factors such as thermal hydraulics, tritium permeation, and gas phase chemistry will be tested as well. The capsule assembly is irradiated in the A2 core position of the Oak Ridge Research Reactor (ORR). Tritium release and recovery is tested by passing a He sweep gas through the solid breeder capsule measuring and collecting the tritium in the sweep stream. The TRIO-01 experiment has extensive on-line monitoring including sweep gas analysis, temperatures, neutron flux, and tritium permeation.

10717 **Overview of first wall/blanket/shield technology.** Nygren, R.E. (Argonne National Lab., Argonne, IL 60439). *Nuclear Technology/Fusion;* 4: No. 2, 1203-1215(Sep 1983). (CONF-830406—).

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This overview of first wall, blanket and shield technology focuses first on trends in important design issues from the 1970's to the 1980's, then on current perceptions of critical issues in first wall, blanket and shield design and related technology. The emphasis is on base technology rather than either systems engineering or materials development, on the two primary confinement systems, tokamaks and mirrors, and on production of electricity as the primary goal for development.

10718 **EBT-P gamma ray shielding analysis.** Gohar, Y. (Argonne National Lab., 9700 South Cass Ave., Argonne, IL 60439). *Nuclear Technology/Fusion;* 4: No. 2, 1159-1164(Sep 1983). (CONF-830406—).

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First, a one-dimensional scoping study was performed for the gamma ray shield of the ELMO Bumpy Torus proof-of-principle device to define appropriate shielding material and determine the required shielding thickness. The dose equivalent results are analyzed as a function of the radiation shield thickness for different shielding options. A sensitivity analysis for the pessimistic case is given. The recommended shielding option based on the performance and cost is discussed. Next, a three-dimensional scoping study for the coil shield was performed for four different shielding options to define the heat load for each component and check the compliance with the design criterion of 10 watts maximum heat load per coil from the gamma ray sources. Also, a detailed biological dose survey was performed which included: a) the dose equivalent inside and outside the building, b) the dose equivalent from the two mazes of the building, and c) the skyshine contribution to the dose equivalent.

10719 **Pressurized - water cooling tube ruptures in a fusion blanket.** Roth, P.A.; Herring, S.J. (EG and G Idaho, Inc. P.O. Box 1625, Idaho Falls, ID 83415). *Nuclear Technology/Fusion;* 4: No. 2, 1121-1126(Sep 1983). (CONF-830406—).

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Recent fusion reactor conceptual designs include pressurized water as the coolant for the first wall and blanket. To determine design adequacy, the consequences of a pressurized water cooling tube failure within the blanket have been analyzed using the time-dependent computer code ATHENA. The ATHENA code, being developed by EG & G Idaho, Inc., simulates safety related transients in fusion blankets, first walls, and other reactor systems. The analysis showed that some blanket design modifications must be made to ensure module integrity following an internal cooling tube break.

10720 **Economic design optimization of the LiPb blanket for the Mirror Advanced Reactor (MARS).** Perkins, L.J.; Kulcinski, G.L. (Univ. of Wisconsin, Nuclear Engineering Dept., 1500 Johnson Drive, Madison, WI 53706). *Nuclear Technology/Fusion;* 4: No. 2, 1107-1112(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A self-consistent procedure has been established for economic design optimization of the lithiumlead (LiPb) blanket for the MARS tandem mirror reactor. The procedure is necessarily iterative and enables progress in blanket design to be assessed in terms of the minimization of an economic figure of merit F for the complete reactor system. Typical economic design questions regarding blanket and central cell parameters such as tritium breeding ratio, neutron energy multiplication factor, thermal cycle efficiency, blanket radial thickness, magnet radii, etc., can then be addressed in terms of their influence on overall system costs. This procedure is not necessarily specific to MARS and has general applicability to fusion reactor blanket design optimization. Application of the procedure resulted in a blanket with small (about 38 cm) radial thickness, highly enriched (90%) lithium, adequate tritium breeding ratio (1.14) and a neutron energy multiplication and thermal efficiency approaching those for blankets of considerably larger radial dimensions.

10721 **An electrically conducting first wall for the fusion engineering device-A (FED-A) tokamak.** Cramer, B.A.; Fuller, G.M. (Fusion Engineering Design Center/McDonnell Douglas Astronautics Co., Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 1095-1100(Sep 1983). (CONF-830406—).

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The first wall of the tokamak FED-A device was designed to satisfy two conflicting requirements. They are a low electrical resistance to give a long eddy-current decay time and a high neutron transparency to give a favorable tritium breeding ratio. The tradeoff between these conflicting requirements resulted in a copper alloy first wall that satisfied the specific goals for FED-A, i.e., a minimum eddy-current decay time of 0.5 sec and a tritium breeding ratio of at least 1.2. Aluminum alloys come close to meeting the requirements and would also probably work. Stainless steel will not work in this application because shells thin enough to satisfy temperature and stress limits are not thick enough to give a long eddy-current decay time and to avoid disruption induced melting. The baseline first wall design is a rib-stiffened, double-wall construction. The total wall thickness is 1.5 cm, including a water coolant thickness of 0.5 cm. The first wall is divided into twelve 30-degree sectors. Flange rings at the ends of each sector are bolted together to form the torus. Structural support is provided at the top center of each sector.

10722 **A neutron-transparent first wall for module testing.** Fuller, G.M.; Cramer, B.A. (Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 1089-1094(Sep 1983). (CONF-830406—).

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Major design goals for FED-R are the achievement of (1) a high level of neutron exposure of the test modules and (2) a capability for rapid changeout of test modules. A major factor in rapid changeout is perceived to be the location of the vacuum boundary. In FED-R this boundary was set at the first wall so that module changeout did not require the plasma chamber to be brought up to atmosphere. Efforts to realize these goals in the design resulted in a neutronically thin outboard wall for the vacuum vessel constructed of 316 stainless steel (SS) with helium as a coolant. A normalized 14-MeV neutron transmission of 0.82 is expected, with an inlet pressure of 2 MPa and a pumping power requirement of 8.7 MW. Other options considered in the study were aluminum as a wall material and water and sodium potassium (NaK) as coolants.

10723 **Design of superheated steam producing blanket for a d-d tokamak.** Dabiri, A.E.; Glancy, J.E. (Science Applications, Inc., P.O. Box 2351, La Jolla, CA 92038). *Nuclear Technology/Fusion;* 4: No. 2, 1079-1083(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A high-temperature first wall/limiter/blanket which would take full advantage of the absence of tritium breeding in a d-d reactor was designed. This design, which produces steam at P = 12.4 MPa and T = 538°C at the blanket exit, eliminates the requirement for a separate steam generator. A steam cycle with steam-to-steam reheat yielding about 40.5 percent efficiency is compatible with this design.

10724 **Fusion breeder blanket design considerations.** Wong, C.P.C.; Creedon, R.L. (GA Technologies Inc., P.O. Box 85608, San Diego, CA 92138). *Nuclear Technology/Fusion;* 4: No. 2, 1073-1079(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The Fusion Breeder Program is a DOE funded program directed by Lawrence Livermore National Laboratory; the other participants in this hybrid fusion reactor design are TRW Company, GA Technologies Inc., Westinghouse Corporation, and Oak Ridge National Laboratory. GA is responsible for the following areas of reactor design: blanket thermal hydraulics, blanket thermal power conversion, fuel handling, blanket and reactor safety, and reprocessing of the bred fuel. The design of the first four areas is reported in this paper.

10725 **Mechanical design and thermal hydraulic considerations for a self-cooled lithium-lead blanket.** Misra, B.; Smith, D.L. (Fusion Power Program, Argonne National Lab., Argonne, IL 60439). *Nuclear Technology/Fusion;* 4: No. 2, 1061-1066(Sep 1983). (CONF-830406—).

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Liquid lithium-lead eutectic alloy (17 at-% Li83 at-% Pb, referred to herein as Li-Pb) is currently being considered as a candidate breeding material for fusion reactors. Some important considerations in the design of a Li-Pb blanket are compatibility with the structure, tritium containment and recovery, and safety. Additional design complexities arise because of the high density of Li-Pb, the relatively high melting temperature (235°C), and the high tritium overpressure associated with this alloy. In this study, the Li-Pb eutectic was considered both as the breeder and as the coolant. Thermal hydraulic and stress analyses were conducted to assess the technical feasibility of using Li-Pb as the breeder and coolant based on DEMO reactor conditions. The results of the thermo-mechanical analyses showed that the elongated cylindrical blanket modules made from either HT-9 or vanadium alloy offer a viable first wall/blanket design concept.

10726 **MARS high temperature blanket.** Gordon, J.D.; Berwald, D.H. (TRW Energy Development Group, One Space Park, R1/2128 Redondo Beach, CA 90278). *Nuclear Technology/Fusion;* 4: No. 2, 1233-1238(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A new, two-zone tandem mirror blanket designed for the dual applications of high efficiency electricity production or process heat for synthetic fuel production is presented. The blanket is selfsufficient in tritium production, delivers 46% of the blanket energy at 900 to 1000°C, meets guidelines for near-surface burial of radioactive wastes and couples to a power cycle that has a net efficiency of 44%. The design is based on a new concept of a dilute mixture of a solid breeder with a high temperature material that extends the temperature range of the breeder. The low temperature zone is $Li_{17}Pb_{83}$ cooled while the high temperature zone is cooled with helium.

10727 **Design of a high temperature first wall/blanket for a d-d Compact Reversed Field Pinch Reactor (CRFPR).** Dabiri, A.E.; Glancy, J.E. (Science Applications, Inc. P.O. Box 2351, La Jolla, CA 92038). *Nuclear Technology/Fusion;* 4: No. 2, 1239-1244(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A high-temperature first wall/blanket which would take full advantage of the absence of tritium breeding in a d-d reactor was designed. This design which produces steam at p = 7 MPa and T = 538°C at the blanket exit eliminates the requirement for a separate steam generator. A steam cycle with steam-to-steam reheat yielding about 37.5 percent efficiency is compatible with this design.

10728 **Lifetime analysis of fusion reactor components.** Mattas, R. (Argonne National Lab., 9700 South Cass Ave., Argonne, IL 60439). *Nuclear Technology/Fusion;* 4: No. 2, 1257-1262(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A one dimensional computer code has been developed to examine the lifetime of first wall and impurity control components. The code incorporates the operating and design parameters, the material characteristics, and the appropriate failure criteria for the individual components. The major emphasis of the modelling effort has been to calculate the temperature-stress-strain-radiation effects history of a component so that the synergystic effects between sputtering erosion, swelling, creep, fatigue, and crack growth can be examined. The general forms of the property equations are the same for all materials in order to provide the greatest flexibility for materials selection in the code. The code is capable of determining the behavior of a plate, composed of either a single or dual material structure, that is either totally constrained or constrained from bending but not from expansion. The code has been utilized to analyze the first walls for FED/INTOR and DEMO.

10729 **Thermal and mechanical design of a doublewalled steam generator.** Schluderberg, D.C.; Huang, J.H. (Babcock and Wilcox Co., Power Generation Group, P.O. Box 1250, Lynchburg, VA 24505). *Nuclear Technology/Fusion;* 4: No. 2, 1509-1513(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A double-walled steam generator is used in the fusion power cycle to replace the intermediate loop. This will save the cost associated with a complicated system and the associated temperature degradation. The mechanical design of the steam generator is similar to that proposed for LMFBR application. The heat transfer and tritium diffusion calculations are performed. The double-walled steam generator provides a tritium diffusion barrier factor $> 10^5$ while increasing the surface area by 25% compared to a singlewalled steam generator.

10730 **Materials compatibility considerations for a fusion-fission hybrid reactor design.** DeVan, J.H.; Tortorelli, P.F. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 421-426(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The Tandem Mirror Hybrid Reactor is a fusion reactor concept that incorporates a fissionsuppressed breeding blanket for the production of ^{233}U to be used in conventional fission power reactors. The present paper reports on compatibility considerations related to the blanket design. These considerations include solid-solid interactions and liquid metal corrosion. Potential problems are discussed relative to the reference blanket operating temperature (490°C) and the recycling time of fissile materials (<1 year).

10731 **Transient tritium transport in a solid breeder blanket.** Hanchar, D.R.; Kazimi, M.S. (Massachusetts Inst. of Technology, Cambridge, MA 02139). *Nuclear Technology/Fusion;* 4: No. 2, 395-400(Sep 1983). (CONF-830406—).

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A transient tritium permeation model is developed based on a simplified conceptual DT-fueled fusion reactor design. The major design features in the model are a solid breeder blanket, a low pressure purge gas in the blanket and a high pressure helium primary coolant. Tritium inventory in the breeder is due to diffusive hold-up and solubility effects. Diffusive hold-up is assumed to be the dominant factor in order to separate the solution for the breeder tritium concentration. The model was applied to the STARFIRE-Interim Reference Design, whose system parameters yielded a breeder tritium inventory on the order of grams. The breeder pellets (average radius, 10^{-3} cm) reach their steady-state tritium content in approximately 4 hours from startup, assuming continuous full power operation. Both the steady-state breeder tritium concentration and the time to reach that steady-state are proportional to the square of the pellet radius.

10732 **The wall tritium concentration as a factor in fusion reactor hall design.** Finn, P.A.; Leonard, R.A. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439). *Nuclear Technology/Fusion;* 4: No. 2, 389-394(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The effect of either concrete or stainless steel walls on the cleanup time required to attain tritium (HTO) atmospheric levels $\leq$ 0.5 mCi/m^3 was assessed. Calculations were performed for concrete; experimental results are presented for stainless steel.

10733 **Comparison between measured and predicted performance of a high speed, free surface liquid jet flowing along a curved wall.** Hassberger, J.A. (Westinghouse Hanford Company, P.O. Box 1970, Richland, WA 99352). *Nuclear Technology/Fusion;* 4: No. 2, 433-438(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Simple predictions of fluid velocities and pressures within a high speed, free surface, curved wall jet are shown to agree favorably with results obtained from hydraulic testing of full scale models. The wall jet described forms the design basis of the Fusion Materials Irradiation Test Facility Lithium Target, and has many similarities with wall jets considered for use in various wetted wall fusion reactor concepts. These comparisons show that simple techniques, both analytic and numerical, provide descriptions of the curved wall jet adequate for selection of design and operating parameters.

10734 **Application of ATHENA to STARFIRE coolant-blanket system analysis.** Rouhani, S.Z.; Jones, J.L. (EG and G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID 83415). *Nuclear Technology/Fusion;* 4: No. 2, 465-470(Sep 1983). (CONF-830406—).

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A case of total power loss and pump stoppage in the STARFIRE fusion reactor has been analyzed with the ATHENA computer code. The computed results indicate total flow stagnation in 200 s, complete evaporation of water in the secondary side of steam generators in 40 s, continued high pressure in the system, and gradual heatup of all neutron multipliers to their melting point in 70 min.

10735 **Control of neutron albedo in toroidal fusion reactors.** Micklich, B.J.; Jassby, D.L. (Princeton Plasma Physics Lab., Princeton, NJ 08544). *Nuclear Technology/Fusion;* 4: No. 2, 477-482(Sep 1983). (CONF-830406—).

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The MCNP and ANISN codes have been used to obtain basic neutron albedo data for materials of interest for fusion applications. Simple physical models are presented which explain albedo dependence on pre- and post-reflection variables. The angular distribution of reflected neutrons is found to be roughly $\cos\theta$ for all materials and all incident energies and angles. The energy spectra of reflected neutrons are presented, and it is shown that substantial variations in the total current at the outboard wall of a torus can be effected by changing materials behind the inboard wall. Analyses show that a maximum of four isolated incident current environments may be established simultaneously on the outboard side of a torus. With suitable inboard reflectors, global tritium breeding ratios significantly larger than unity can be produced in limited coverage breeding blankets.

10736 **Transport scaling studies for EBT reactor.** Uckan, T.; Jaeger, E.F. (Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 507-512(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Transport simulation and modeling studies for the ELMO Bumpy Torus (EBT) reactor are carried out by using 0-D and 1-1/2-D transport calculations. The time-dependent 0-D model is used for global analysis whereas the 1-1/2-D radial transport code is used for accurate determination of density, temperature, and ambipolar potential profiles and of the role of these profiles in reactor plasma performance. Analysis with the 1-1/2-D transport code shows that profile effects near the outer edge of the hot electron ring lead to enhanced confinement by at least a factor of 2-5 beyond the simple scaling that is obtained from the global analysis. The radial profiles of core plasma density and temperatures (or core pressure) obtained from 1-1/2-D transport calculations are found to be similar to those theoretically required for stability.

10737 **Low cost shield for Tokamak Fusion reactors.** Gohar, Y. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439). *Nuclear Technology/Fusion;* 4: No. 2, 373-380(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A low cost shielding system was developed for the Demonstration Tokamak Power Plant. The shielding system was designed with low cost materials to fulfill several functions and satisfy the design criteria. The reference shielding materials are water, ordinary concrete, Fe14Mn2Ni2Cr steel alloy, boron carbide, and lead.

The cost of this shielding system is only 3% of the total direct cost compared to 11% in the STARFIRE design.

10738 **Coaxial test fixture and pulsed power supply for contact material screening tests.** Praeg, W.F.; McGhee, D.G. (Argonne National Lab., 9700 South Cass Ave., Argonne, IL 60439). *Nuclear Technology/Fusion;* 4: No. 2, 1491-1496(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A coaxial test fixture and a pulsed power supply have been built to conduct high current screening tests on candidate materials for contacts to be used in first wall connectors on fusion devices, particularly tokamaks. The fixture was operated with half sine wave pulses of ≦ 300 kA; it is designed for carrying currents of up to 600 kA for approximately 300 ms at a repetition rate of 1 pulse every 5 minutes. The fixture is built as a vacuum vessel and capable of testing specimens in an ambient temperature of 300°C. Instrumentation is provided to measure the current pulse, contact voltage drop, contact pressure, the strain caused by contact pressure, and the operating temperature. The test fixture, its power supply and possible future upgrades are described.

10739 **Implantation measurements to determine tritium permeation in first wall structures.** Holland, D.F.; Causey, R.A. (EG and G Idaho, Inc./Fusion Technology, P.O. Box 1625, Idaho Falls, ID 83415). *Nuclear Technology/Fusion;* 4: No. 2, 677-680(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A principal safety concern for a D-T burning fusion reactor is release of tritium during routine operation. Tritium implantation into first wall structures, and subsequent permeation into coolants, is potentially an important source of tritium loss. This paper reports on an experiment in which an ion accelerator was used to implant deuterium atoms in a stainless steel disk to simulate tritium implantation in first wall structures. The permeation rate was measured under various operating conditions. These results were used in the TMAP computer code to determine potential tritium loss rates for fusion reactors.

10740 **Ripple reduction coils for tokamak reactors.** Bateman, G.; Fox, J.R. (Georgia Inst. of Technology, Atlanta, GA 30332). *Nuclear Technology/Fusion;* 4: No. 2, 1363-1367(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Ripple Reduction Poloidal Field (RRPF) coils together with blocks of ferro-magnetic iron shielding are used to design a commercial tokamak reactor similar in size to STARFIRE with only eight rather than twelve toroidal field (TF) coils. The RRPF coils function like segmented poloidal field coils, placed between the TF coils and the neutron shielding, carrying an average of + or -6 MA turns of current in the toroidal direction. Together with an additional pair of vertical field coils carrying 4.8 MAT, they produce the poloidal field needed for a $<B> \simeq 6\%$ plasma equilibrium with elongation 1.68 and a pair of separatrices suitable for a poloidal divertor. The RRPF coils also reduce magnetic ripple near the top and bottom of the plasma while the laminated blocks of iron magnetic shielding placed under each TF coil reduce magnetic ripple at the outer edge of the plasma near the midplane from a maximum of 5.48% to less than 1%.

10741 **Toroidal field resistive magnet design for tokamak test reactors.** Mooper, R.J.; Kalsi, S.S. (Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 1341-1345(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The design of resistive copper toroidal field (TF) coils is described for use in a nearterm tokamak fusion device (FED-R). A design requirement on the TF coils is that they contain readily demountable joints to facilitate replacement of components inside the bore of the coil. The coils are fabricated from rectangular window frame plates with 1-m-radius fillets in the inside corners. Each coil contains 17 turns - fabricated from CDA-110 copper plate segments 6.1 cm thick. Because of high radiation fluence, a ceramic turn-to-turn insulator is used. The cooling system is sized to accommodate the combined heat loading that results from resistive power dissipation and nuclear heating.

10742 **Structural design considerations for the FED 50-kA equilibrium field coils.** Buchanan, G.; Bennett, J.G. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). *Nuclear Technology/Fusion;* 4: No. 2, 1352-1356(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The structural support system for two equilibrium field coil conductor concepts is considered for the fusion energy design (FED) 8/10T baseline magnetic fusion system. Both conductor concepts are discussed. Results indicate that regardless of the conductor concept employed, an external support beam/frame structural system is required to equilibrate the accumulative loadings.

10743 **A unified study for determining poloidal field coil locations for a tokamak.** Srivastava, V.C.; Kalsi, S.S. (Fusion Engineering Design Center/General Electric Company, Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 1357-1361(Sep 1983). (CONF-830406—).

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The poloidal field (PF) configuration has a major impact on the size and cost of tokamak machines. This report describes a procedure for developing a minimum cost PF system consistent with constraints imposed by plasma, magnet, and configurational design requirements. This methodology is considered adequate for developing the PF coil configurations. PF configuration studies are described for the International Tokamak Reactor (INTOR) as an illustration. The total cost of the PF system increases appreciably when an idealized PF configuration (with discrete coils) is replaced by a more practical coil configuration. The PF system with a poloidal divertor costs about 50% more than a system utilizing limiter-type impurity control.

10744 **Plasma engineering for MARS.** Carlson, G.A.; Baldwin, D.E. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA 94550). *Nuclear Technology/Fusion;* 4: No. 2, 513-518(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The two-year Mirror Advanced Reactor Study (MARS) has resulted in the conceptual design of a commercial, electricity-producing fusion reactor based on tandem mirror confinement. The physics basis for the MARS reactor was developed through work in two highly coupled areas of plasma engineering: magnetics and plasma performance.

10745 **Neutron activation in EBT-P.** Driemeyer, D.E. (McDonnell Douglas Astronautics Co., St. Louis Div., P.O. Box 516, St. Louis, MO 63166). *Nuclear Technology/Fusion;* 4: No. 2, 1183-1188(Sep 1983). (CONF-830406—).

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Neutron activation due to photoneutron production in the lead shields proposed to protect the EBT-P superconducting coils from excessive x-ray heating was investigated. The photoneutron flux distribution in various EBT-P structural components was calcualted for typical upgrade operating conditions using a standard twodimensional transport model (TWOTRAN). Activity levels were then evaluated for major structural materials using activation cross sections tabulated in the GAMMON library. Activation dose rates in the device enclosure following several days of 8h/day upgrade (90GHz) operation were found to be about6 mrem/h, decaying to <0.25 mrem/h in about3 days. This requires radition monitoring of all personnel entering the device enclosure during this time, but should not generally restrict "hands on" access to the device. There is thus no strong motivation to replace lead with another shield material; however, it may be desirable to borate the enclosure walls in order to reduce the effect which impurities might have on activity levels.

10746 **Development of the two-dimensional cross-section sensitivity and uncertainty analysis code SENSIT-2D with applications to the FED.** Embrechts, M.; Dudziak, D.J. (Los Alamos National Lab., P.O. Box 1663, MS-F641, Univ. of California, Los Alamos, NM 87545). *Nuclear Technology/Fusion;* 4: No. 2, 1195-1200(Sep 1983). (CONF-830406—).

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Sensitivity and uncertainty analyses compliment the information obtained from a transport code by providing a reasonable estimate for the uncertainty of a particular design parameter and a better understanding of the nucleonics involved. The toroidal geometry of many fusion devices motivates a two-dimensional calculation capability. A two-dimensional cross-section and secondary energy distribution (SED) sensitivity and uncertainty analysis code, SENSIT-2D, has been developed that allows modeling of a toroidal geometry. Twodimensional and one-dimensional sensitivity analyses for the heating and the copper d.p.a. of the TF coil for a conceptual FED blanket/shield design were performed. The uncertainties from the two-dimensional analysis are of the same order of magnitude as those obtained from the one-dimensional study. The largest uncertainties were caused by the cross-section covariances for chromium.

10747 **MARS axicell radiation damage and shielding analysis.** El-Guebaly, L.; Perkins, L.J. (Nuclear Engineering Dept., 1500 Johnson Drive, Madison, WI 53706). *Nuclear Technology/Fusion;* 4: No. 2, 1171-1176(Sep 1983). (CONF-830406—).

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Radiation effects and shield requirements are analyzed for the MARS axicell region. Dominant coil life limiting effects in the normal insert coils are found to be swelling in the spinel insulation and resistivity changes of the conductor due to transmutations. The shield between the insert and superconducting coils is optimized and reduces all radiation responses to acceptable levels. However, streaming in the neutral beam duct resulted in an unacceptable dpa rate in the Cu stabilizer and has resulted in a redesign of this region without a neutral beam and with a single insert coil.

10748 **Alternative dispositions for irradiated superconducting magnet materials.** Maya, I.; Levine, H.E. (GA Technologies Inc., P.O. Box 81608, San Diego, CA 92138). *Nuclear Technology/Fusion;* 4: No. 2, 1141-1145(Sep 1983). (CONF-830406—).

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Three options for the disposition of irradiated materials from the STARFIRE toroidal field (TF) magnets were examined, namely, (1) preparation of the irradiated magnet for the subsequent refabrication of a new magnet using the irradiated materials, (2) reprocessing of selected materials and the subsequent manufacturing of a new magnet using these and new materials with standard fabrication techniques, and (3) disposal of the irradiated magnet material. The results indicate that refabrication of a magnet using the acceptable components of the irradiated magnet is technologically feasible. The total cost of refabricating the 12 TF magnets was estimated to be $21 million in 1982 dollars. since this option avoids the purchase of new magnets which would cost over $170 million, it is the preferred economic choice. In comparison, reprocessing and recycling of the magnet materials through standard channels of trade yields a net profit of $0.4 million, but requires the purchase of a new set of magnets. In the event that the old magnets are unusable (e.g., as a result of significant advances in magnet design or severe accidental damage), reprocessing of the TF-coil materials can be used to recover the decommissioning costs associated with the STARFIRE magnets. Lastly, the low induced radioactivity levels in the magnets permit their qualification as Class A radioactive waste. Simply disposing of the magnets via shallow land burial was estimated to cost $3 million, including all the associated costs of dismantling, packaging, shipping, and ultimate disposal.

10749 **Modular Stellarator Reactor conceptual design study.** Miller, R.L.; Bathke, C.G. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). *Nuclear Technology/Fusion;* 4: No. 2, 1308-1313(Sep 1983). (CONF-830406—).

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A conceptual design study of the Modular Stellarator Reactor is summarized. The physics basis of the approach is elucidated with emphasis on magnetics performance optimization. Key engineering features of the fusion power core are described. Comparisons with an analogous continuous-helical-coil (torsatron) system are made as the basis of a technical and economic assessment.

10750 **Physical and engineering constraints for tokamak reactors with helical coils.** Potok, R.E.; Becker, H. (Plasma Fusion Center, Massachusetts Inst. of Technology, Cambridge, MA 02139). *Nuclear Technology/Fusion;* 4: No. 2, 1314-1319(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The authors present an analytical and numerical analysis of a tokamak reactor with a set of helical coils added in order to eliminate plasma disruptions. The optimal helical configuration was found to be a set of continuous, $l = 2$ stellarator coils which are made of copper and are internal to the toroidal field coils, l being the number of poloidal field periods. (The optimization process did not include evaluation of the viability of a modular stellarator reactor). Scaling laws were developed for this optimal configuration, and a series of parametric scans are performed with varying assumptions for the forces on the helical coils and the ratio of helical coil transform to plasma transform (M). The option space available for attractive reactor designs is strongly constrained and involves large forces on the helical coils, low q plasma operation (q being the plasma safety factor), and moderately low M (3 to 5). Numerical calculations showed that M must be > 3 in order to obtain well defined flux surfaces. This is in agreement with results from the JIPP-T-II Tokomak.

10751 **EBT reactor characteristics consistent with stability and power balance requirements.** Uckan, N.A.; Santoro, R.T. (Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 1326-1331(Sep 1983). (CONF-830406—).

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This paper summarizes the results of a recent EBT reactor study that includes both ring and core plasma properties and consistent treatment of coupled ring-core stability criteria and power balance requirements. The principal finding is that constraints imposed by these coupling and other physics and technology considerations permit a broad operating window for reactor design optimization. A number of concept improvements are also proposed that are found to offer the potential for further improvement of the reactor size and parameters.

10752 **Design and fabrication of the iron core for the OHTE experimental machine.** Curwen, B.; Franklin, L.H. (GA Technologies Inc., P.O. Box 85608, San Diego, CA 92138). *Nuclear Technology/Fusion;* 4: No. 2, 1373-1377(Sep 1983). (CONF-830406—).

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The Ohmically Heated Toroidal Experiment (OHTE) is a toroidal pinch magnetic confinement plasma experiment which has been operating at GA Technologies (GA) since February 1981. In its original form, plasma current was induced by an air core induction or ohmic heating coil driven by a capacitor bank. Preliminary study revealed that greater plasma currents and pulse lengths could be achieved more economically by converting to an iron core rather than by installing additional capacitors. Therefore an iron core with a 3 volt-second capability and a stepped configuration was designed, fabricated and incorporated into the OHTE experimental device as part of a planned upgrade. To facilitate handling and installation, the iron core was fabricated in 28 segments consisting of 14 lower and 14 identical upper segments. Space limitations

in the center of the machine created by existing geometry limited the flux path to approximately 1.28 m diameter or 1.296 m^2. Using a stacking factor of 90% and allowing 3 mm between segments results in a true iron cross section of 1.12 m^2. Each segment was fabricated by continuously winding in a "clockspring fashion" around a hardwood former Armco electrically oriented steel, 0.35 mm thick and 88 mm wide. Interspaced between laminations is insulating paper 0.02 mm thick and 88 mm wide bonded to the steel using a structural epoxy adhesive continuously applied during winding. After winding and curing, support saddles consisting of hardwood and aluminum were bonded to the segments. The segments were then cut into two identical halves on a large vertical milling machine. To eliminate electrical shorts, all machined surfaces were etched with a dilute nitric acid solution, then painted with a moisture repelling high dielectric strengt epoxy spray paint to eliminate lamination to lamination creepage and surface corrosion.

10753 **Nondestructive testing of metallic sheath for internally cooled superconductor.** McCluny, R.W.; Cook, K.V. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 1378-13(Sep 1983). (CONF-830406—).

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For quality assurance in the Oak Ridge National Laboratory Large Coil Program, the authors developed ultrasonic and eddy-current techniques to examine the JBK-75 alloy sheath for superconducting cable for a large magnet. Ultrasound was used to examine the strip before forming into the sheath, and eddy currents were used to examine the seam weld after the sheath had been formed around the cable.

10754 **Long term ETR/INTOR magnet testing in support of the demonstration fusion reactor.** Herring, S.J.; Shah, V.N. (EG and G Idaho, Inc., Fusion Safety, P.O. Box 1625, Idaho Falls, ID 83415). *Nuclear Technology/Fusion;* 4: No. 2, 1384-1391(Sep 1983). (CONF-830406—).

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This study considers ways that the proposed Engineering Test Reactor (ETR), or the proposed International Tokamak Reactor (INTOR), can be used for magnet performance tests that would be useful for the design and operation of the Demonstration Tokamak Power Plant (DEMO). Such testing must not interfere with the main function of the ETR/INTOR as an integrated fusion reactor. A performance test plan for the ETR/INTOR magnets is proposed and appropriate tests on the magnets for each phase of the ETR/INTOR operation are described. The suggested tests would verify design requirements and monitor long-term changes due to radiation. This paper also summarizes the design and operational performance of existing superconducting magnets and identifies the known failures and their predominant causes. In addition, existing radiation dose-damage information and criteria that relate material property change with component failure are combined with predicted neutron and gamma dose rates at the ETR/INTOR magnet position to estimate the time to insulator and conductor failure in this reactor. Long-term operation of magnets in a pulsed plasma environment such as in the ETR/INTOR, however, may aggravate the effect of gamma and neutron radiation on the insulators. To provide more accurate time-to-failure information for magnet component material, accelerated irradiation of magnet material coupons in the ETR/INTOR and in other irradiation facilities is suggested.

10755 **Proposed EBT-P quench detection technique in a magnetically noisy environment.** Lieurance, D.W.; Cunningham, S.U. (General Dynamics Convair Div., San Diego, CA 92138). *Nuclear Technology/Fusion;* 4: No. 2, 1392-1397(Sep 1983). (CONF-830406—).

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The presence of large magnetic interferences in the EBTP plasma makes the detection of normal zones in the superconductor extremely difficult. A technique has been developed to model these magnetic noises and coil components as mutual inductances. The computer program SPICE was then used to develop a proposed conceptual circuit for reliable protection of the EBT-P mirror coils in the 60 GHz mode that may later be upgraded to 90 GHz operations.

10756 **Microwave transport in EBT distribution manifolds using Monte Carlo ray tracing techniques.** Lillie, R.A.; White, T.L. (Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 1436-1444(Sep 1983). (CONF-830406—).

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Ray tracing Monte Carlo calculations have been carried out using an existing Monte Carlo radiation transport code to obtain estimates of the microwave power exiting the torus coupling links in EBT microwave manifolds. The microwave power loss and polarization at surface reflections were accounted for by treating the microwaves as plane waves reflecting off plane surfaces. Agreement on the order of 10% was obtained between the measured and calculated output power distribution for an existing EBT-S toroidal manifold. A cost effective iterative procedure utilizing the Monte Carlo history data was implemented to predict design changes which could produce increased manifold efficiency and improved output power uniformity.

10757 **Overview and direction in the tandem mirror program.** Thomassen, K.I. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA 94550). *Nuclear Technology/Fusion;* 4: No. 2, 62-66(Sep 1983). (CONF-830406—).

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There are two main thrusts to the tandem mirror program at the present time. One is to gather the experimental data base to verify the axicell thermal barrier concept and the other to improve the end plugs for tandems. With such improvements one might approach the ideal fusion reactor, a simple solenoid of modular elements whose ends are but a modest perturbation on the configuration from both a cost and technological view point. Progress toward these two goals is discussed here, and the directions to be taken in the immediate future are described.

10758 **Disruption induced voltages and loads on torus sectors.** Thome, R.J.; Pillsbury, R.D. Jr. (Plasma Fusion Center, Massachusetts Inst. of Technology, Cambridge, MA 02139). *Nuclear Technology/Fusion;* 4: No. 2, 453-458(Sep 1983). (CONF-830406—).

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The rapid decay of magnetic flux during a plasma disruption induces voltages, currents, and Lorentz loadings in nearby electrically-conducting material. Present designs employ toroidal shells or shell segments near the plasma. These shells are divided into sectors for assembly and maintenance considerations, but may have toroidally-continuous conducting paths due to the need for vacuum boundaries. Voltages induced across sector gaps may initiate arcing and subsequent material damage. In addition, induced eddy currents in the shells can interact with the toroidal field and generate large net torques on a sector. A finite element model was used to estimate the induced sector gap voltages and net overturning moments following a 10 ms disruption. The number of shells, toroidal continuity, resistivity, and shell thicknesses were varied. Results are presented that show the effects of these changes on the sector gap voltages and induced loads.

10759 **Particle confinement in EBT reactors with noncircular mirror coils.** Owen, L.W.; Uckan, N.A. (Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 519-523(Sep 1983). (CONF-830406—).

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Methods of improving single particle confinement in the vacuum magnetic field of an ELMO Bumpy Torus (EBT) reactor have heretofore focused on enhancement of the effective magnetic aspect ratio through the addition of relatively low current supplementary coils to the basic EBT configuration of toroidally linked circular mirror coils. This method of aspect ratio enhancement is reviewed and compared to the use of noncircular, D-shaped mirror coils. A critical parameter in this evaluation is the required radial

thickness δ of the blanket-shield assembly in the coil throat. Results indicate the D-coils represent an attractive alternative to the supplementary coil configurations if future neutronics calculations show that $\delta \leq 1.1\text{-}1.2$ m gives adequate neutron shielding and acceptable minimal breeding ratio under the coils. D-coils are shown to be extremely effective in symmetrizing mod-B in the midplane, thereby giving good trapped particle confinement, hot electron ring centering, and reactor volume utilization. In addition, magnetics systems with D-coils are significantly less complicated, with easier assembly, maintenance, and access, than configurations in which there are two supplementary coils per sector.

10760 **Maintenance and disassembly considerations for the Technology Demonstration Facility.** Spampinato, P.T. (Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 194-199(Sep 1983). (CONF-830406—).

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The Technology Demonstration Facility (TDF) is a tandem mirror design concept carried out under the direction of Lawrence Livermore National Laboratory. It was conceived as a near-term device with a mission of developing engineering technology in a D-T fusion environment. Overall maintenance and component disassembly were among the responsibilities of the Fusion Engineering Design Center (FEDC). A configuration evolved that was based on the operational requirements of the components, as well as the requirements for their replacements. Component lifetime estimates were used to estimate the frequency and the number of replacements. In addition, it was determined that the need for remote handling equipment followed within 1.5 years after initial start-up, emphasizing the direct relationship between developing maintenance scenarios/equipment and the device configuration. Many of the scheduled maintenance operations were investigated to first order, and preliminary handling equipment concepts were developed.

10761 **Thermal - structural analysis and conceptual design of the MARS direct converter.** Luzzi, T.E.; Fiscler, S.Z. (Grumman Aerospace Corp., Bethpage, NY 11741). *Nuclear Technology/Fusion;* 4: No. 2, 1467-1472(Sep 1983). (CONF-830406—).

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A thermal and structural conceptual design and an analysis of tritium permeation are presented for the grid tubes and collector plate of the interim MARS tandem mirror reactor. Designs are presented for two thermal recovery concepts, a water coolant with low outlet temperature and gaseous coolant with high outlet temperature. System analyses were conducted for the grids. For the grids both radiative and actively cooled schemes were investigated. Three water cooled grid tube point designs were studied. For the liquid cooled collector, five coolant channel configurations were considered. A reference design was chosen for the grids and collecter plates.

10762 **Development of hydrogen pellet injectors at ORNL.** Combs, S.K.; Milora, S.L. (Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 666-674(Sep 1983). (CONF-830406—).

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Pellet injectors that produce and accelerate frozen hydrogen isotope pellets are being developed at Oak Ridge National Laboratory (ORNL) for fueling of present and future plasma fusion devices. The development has focused primarily on two types of injectors: (1) gas guns, which utilize a pneumatic approach to accelerate pellets in a barrel with compressed helium or hydrogen propellant, and (2) centrifuge-type injectors, in which pellets are accelerated by centrifugal forces in a highspeed rotating track. In a single-pellet pneumatic injector, pellet speeds up to 1.4 km/s have been achieved. Three multipellet injection systems (ORNL four-pellet pneumatic design) are now functional, one each on the Poloidal Divertor Experiment (PDX), Alcator-C, and the Impurity Study Experiment (ISX-B). Currently, two repetitive devices (one of each injector type) are in operation to demonstrate steadystate fueling systems in the reactor-relevant parameter ranges of 1-km/s pellet velocity, variable pellet sizes up to 2 mm, and feed rates up to 10-40 pellets/s. The injector designs are described and operating characteristics discussed.

10763 **Streaming and shielding analysis for the NBI system of TDF.** Sawan, U.E. (Nuclear Engineering Dept., 1500 Johnson Drive, Univ. of Wisconsin, Madison, WI 53706). *Nuclear Technology/Fusion;* 4: No. 2, 355-360(Sep 1983). (CONF-830406—).

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Three-dimensional neutronics and photonics analysis has been performed for the neutral beam injection system of TDF. Using tungsten shield in the 0.35 m space available between the corner of the central cell solenoid and the duct wall provides adequate protection for the magnet. The peak radiation damage and nuclear heating in the magnet are well below the specified design limits. Acceptable heat loads were obtained in the cryopanels and superconductive shield. The radiation dose absorbed in the MACOR insulator of the ion source implies that it will last approximately 2.8 full power years.

10764 **Computational simulation of Spheromak plasma heating.** Olson, R.E.; Miley, G.H. (Univ. of Illinois, Fusion Studies Lab., 103 S. Goodwin Ave., Urbana, IL 61801). *Nuclear Technology/Fusion;* 4: No. 2, 1459-1464(Sep 1983). (CONF-830406—).

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Time-dependent computational simulations using both single-fluid O-D and two-fluid 1 1/2-D models are developed for and utilized in an investigation of the ohmic heating of a Spheromak plasma. The plasma density and composition, the applied magnetic field strength, the plasma size, and the plasma current density profile are considered for their effects on the Spheromak heating rate and maximum achievable temperature. The feasibility of ohmic ignition of a reactor-size pheromak plasma is also contemplated.

10765 **Analysis of drift ducts for TDF neutral beam injectors.** Vetrovec, J. (Energy Development Group, TRW Inc., Redondo Beach, CA 90278). *Nuclear Technology/Fusion;* 4: No. 2, 1453-1458(Sep 1983). (CONF-830406—).

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Neutral beams are injected into fusion devices through narrow transition ducts that are permeated by strong magnetic fields. As a result, the beam particles that undergo reionizing collisions with thermal gas molecules within the duct are deflected by the magnetic field onto the duct wall. This phenomena in conjunction with other related effects has been responsible for significant reduction in the amount of beam power reaching the plasma. This paper describes the development of a self-consistent beam transport model that was extensively used in the design of neutral beam injector system for the TDF central cell.

10766 **The design method for a control process for multiple source electron cyclotron resonance heating for the Elmo Bumpy Torus proof of principle device.** Weaver, T.L. (McDonnell-Douglas Astronautics Co., P.O. Box 516, St. Louis, MI 63166). *Nuclear Technology/Fusion;* 4: No. 2, 1442-1447(Sep 1983). (CONF-830406—).

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A method for generating a control process for the Elmo Bumpy Torus electron cyclotron resonance heating system was developed. The method developed was a general-to-specific method inspired by methods of structured software development. It had a dual structure which put the physical system analysis and the process analysis on equal footings. The method resulted in a two branch, multilayered product, various parts of which led directly to the several final products required for plasma heating control.

10767 Experimental database and design concept for a 1-MW, 200-keV neutral beam line based on a SITEX negative ion source. Dagenhart, W.K.; Gardner, W.L. (Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 1430-1435(Sep 1983). (CONF-830406—).

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Scaling studies for a SITEX negative ion source to produce 200-keV, 10-A, long pulse D^- beams are under way at Oak Ridge National Laboratory (ORNL). Designs have been restricted to the use of established techniques and reasonably welldemonstrated scaling. The results show that the 1-A SITEX source can be directly scaled to produce 200-keV, 10-A long pulse ion beams with a source power efficiency of ≦5 kW of total plasma generator power per ampere of D^- beam generated. Extracted electron-to-D^- ratios should be ≦0.06, with all extracted electrons recovered at ≦10% of the first gap potential energy difference. The close-coupled accelerating structure will be 5 cm long and have five electrodes with 21 slits each, with a 50-kV/cm field in each gap. No decel electrode was included because of the transverse magnetic field. Electrons formed in each gap by the about16% charge-exchange loss of D^- in the total accelerator column will be collected by electron recovery structures associated with the gaps at an average energy of 50% of a gap's potential energy difference. Atomic gas efficiency will be ≧67%. Beam divergence calculations using the ORNL optics code give θ /SUB rms/ = + or -0.4°. The ion source magnetic field provides momentum dispersion of the extracted beam, separating out both the electrons and all heavy ion impurities and low energy D^0 particles formed by charge exchange in the accelerating column. A D_2 gas neutralization cell and a charge separation magnet provide 1 MW of D^0 beam at 200 keV for injection. The overall beam line dimensions are 2.2 X 1.0 X 5.0 m (H X W X L).

10768 Development of a long-pulse (30-s), high-energy (120-keV) ion source for neutral beam applications. Tsai, C.C.; Barber, G.C. (Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 1424-1429(Sep 1983). (CONF-830406—).

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Multimegawatt neutral beams of hydrogen or deuterium atoms are needed for fusion machine applications such as MFTF-B, TFTR-U, DIII-U, and FED (INTOR or ETR). For these applications, a duoPIGatron ion source is being developed to produce high-brightness deuterium beams at a beam energy of about120 keV for pulse lengths up to 30 s. A long-pulse plasma generator with active water cooling has been operated at an arc level of 1200 A with 30-s pulse durations. The plasma density and uniformity are sufficient for supplying a 60-A beam of hydrogen ions to a 13- by 43-cm accelerator. A 10- by 25-cm tetrode accelerator has been operated to form 120-keV hydrogen ion beams. Using the twodimensional (2-D) ion extraction code developed at Oak Ridge National Laboratory (ORNL), a 13 by 43-cm tetrode accelerator has been designed and is being fabricated. The aperture shapes of accelerator grids are optimized for 120-keV beam energy.

10769 Efficient, radiation-hardened, 400 and 800-keV neutral beam injection systems. Anderson, O.A.; Cooper, W.S. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). *Nuclear Technology/Fusion;* 4: No. 2, 1418-1423(Sep 1983). (CONF-830406—).

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The authors present designs for two negative-ion based neutral beam lines with reactor-level power output. Both beam lines make use of such technologically advanced features as high-current-density surface-conversion ion sources, transverse-field-focussing (TFF) acceleration and transport, and laser photo detachment. For the second of these designs, detailed beam and vacuum calculations are presented, as well as a brief description of a proof-of-principle test system currently under development.

10770 Engineering aspects of low hybrid microwave injection into the Alcator C tokamak. Schuss, J.J.; Porkolab, M. (Plasma Fusion Center, Massachusetts Inst. of Technology, Cambridge, MA 02139). *Nuclear Technology/Fusion;* 4: No. 2, 1413-1417(Sep 1983). (CONF-830406—).

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The authors describe here the RF system currently installed on Alcator C that is being used to inject in excess of 1 MW of net RF power into the tokamak plasma during lower hybrid heating and current drive studies. This system provides for RF power and phase monitoring in each of the individual waveguides of the two 16 waveguide launching arrays, and also for fault protection both at the waveguide arrays and klystrons. Using this system good waveguide-plasma coupling has been obtained and net RF power densities of 9 kW/cm² have been injected by the waveguide array without microwave arcing.

10771 Engineering design of the quasi-optical ECRH injection system for the mirror advanced reactor (MARS). Perkins, J.; Freije, S.A. (Nuclear Engineering Dept., Univ. of Wisconsin, Madison, WI 53706). *Nuclear Technology/Fusion;* 4: No. 2, 1407-1412(Sep 1983). (CONF-830406—).

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The engineering design of two high-power steadystate ECRH injection systems is presented for the MARS tandem mirror reactor. With a design power of 57 MW, System I is comprised of 1 MW cavity-mode gyrotrons coupled to a novel quasioptical launching system for the combination and transmission of the ECRH power to the plasma. System II has a design power of 84 MW and comprises 2.5 MW quasi-optical gyrotron units coupled to a quasi-optical launching system similar in principle to System I but displaying minimal space requirements. Potential operating conditions, parameters and constraints are presented for multi-MW gyrotrons and quasi-optical launching systems, and key ECRH development and technology needs for commercial tandem mirror reactors are defined.

10772 MARS heating systems. Freije, S.A.; Goebel, D.U. (Oak Ridge National Lab., P.O. Box Y - FEDC Bldg., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 1401-1406(Sep 1983). (CONF-830406—).

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The conceptual designs of the supplemental heating systems for a tenth of a kind, commercial tandem mirror reactor have been developed. A high power ECRH system at 60GHz maintains the thermal barrier in each endcell and a second low power system at 71GHz increases the magnitude of the potential peak. The sloshing ion distribution in the plug is produced by a 475KeV negative ion neutral beam. An ICRH system provides a hot plasma in the anchor region for pressure weighting of the geodesic curvature, thus ensuring stability.

10773 Radio-frequency energy in fusion power generation. Lawson, J.Q.; Becraft, W.R. (Princeton Plasma Physics Lab., Princeton, NJ 08540). *Nuclear Technology/Fusion;* 4: No. 2, 647-653(Sep 1983). (CONF-830406—).

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The history of radio-frequency (RF) energy in fusion experiments is reviewed, and the status of current efforts is described. Potential applications to tasks other than plasma heating are described, as are the research and development needs of RF energy technology.

10774 RF coupler technology for fusion applications. Hoffman, D.J. (Fusion Energy Division, Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 642-646(Sep 1983). (CONF-830406—).

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Radio frequency (RF) oscillations at critical frequencies have successfully provided a means to convey power to fusion plasmas due to the electrical-magnetic properties of the plasma. While large RF systems to couple power to the plasma have been designed, built, and tested, the main link to the plasma, the coupler, is still in an evolutionary stage of development. Design and fabrication of optimal antennas for fusion applications are complicated by incomplete characterizations of the harsh plasma environment and

of coupling mechanisms. A brief description of RF coupler technology required for plasma conditions is presented along with an assessment of the status and goals of coupler development.

10775 **Safety considerations in the design of the fusion engineering device.** Barrett, R.J. (Fusion Engineering Design Center/Burns and Roe, Inc.). *Nuclear Technology/Fusion;* 4: No. 2, 555-560(Sep 1983). (CONF-830406—).

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Safety considerations play a significant role in the design of a near-term Fusion Engineering Device (FED). For the safety of the general public and the plant workers, the radiation environment caused by the reacting plasma and the potential release of tritium fuel are the dominant considerations. The U.S. Department of Energy (DOE) regulations and guidelines for radiation protection have been reviewed and are being applied to the device design. Direct radiation protection is provided by the device shield and the reactor building walls. Radiation from the activated device components and the tritium fuel is to be controlled with shielding, contamination control, and ventilation. The potential release of tritium from the plant has influenced the selection of reactor building and plant designs and specifications. The safety of the plant workers is affected primarily by the radiation from the activated device components and from plasma chamber debris. The highly activated device components make it necessary to design many of the maintenance activities in the reactor building for totally remote operation. The hot cell facility has evolved as a totally remote maintenance facility due to the high radiation levels of the device components. Safety considerations have had substantial impacts on the design of FED. Several examples of safety-related design impacts are discussed in the paper. Feasible solutions have been identified for all outstanding safety-related items, and additional optimization of these solutions is anticipated in future design studies.

10776 **The effective cost of tritium for tokamak fusion power reactors with reduced tritium production systems.** Gilligan, J.G.; Evans, K. (Univ. of Illinois, Fusion Studies Lab., 103 S. Goodwin Avenue, Urbana, IL 61801). *Nuclear Technology/Fusion;* 4: No. 2, 273-278(Sep 1983). (CONF-830406—).

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If sufficient tritium cannot be produced and processed in tokamak blankets then at least two alternatives are possible. Tritium can be purchased; or reactors with reduced tritium (RT) content in the plasma can be designed. The latter choice may require development of magnet technology etc., but the authors show that the impact on the cost-of-electricity may be mild. Cost tradeoffs are compared to the market value of tritium. Adequate tritium production in fusion blankets is preferred, but the authors show there is some flexibility in the deployment of fusion if this is not possible.

10777 **Risk assessment techniques for the evaluation of tritium accident mitigation.** Bruske, S.Z.; Holland, D.F. (EG and G Inc./Reliability and Statistics, P.O. Box 1625, Idaho Falls, ID 83415). *Nuclear Technology/Fusion;* 4: No. 2, 539-543(Sep 1983). (CONF-830406—).

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The probabilistic risk assessment (PRA) methodology provides a means to systematically examine the potential for accidents that may result in a release of hazardous materials. A PRA of a typical fusion reactor fuel processing system has been performed. This paper specifically evaluates the effectiveness of tritium accident mitigation systems. The results of the evaluation are presented in a probability-consequence curve which describes the probability of various accident release magnitudes.

10778 **The status of tritium technology development for magnetic fusion energy.** Anderson, J.L. (Los Alamos National Lab., Los Alamos, NM 87545). *Nuclear Technology/Fusion;* 4: No. 2, 75-82(Sep 1983). (CONF-830406—).

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The development of tritium technology for the magnetic fusion energy program has progressed at a rapid rate over the past two years. The focal points for this development in the United States have been the Tritium Systems Test Assembly at Los Alamos and the FED/INTOR studies supported by the Fusion Engineering Design Center at Oak Ridge. In Canada the Canadian Fusion Fuel Technology Project has been initiated and promises to make significant contributions to the tritium technology program in the next few years. The Japanese government has now approved funding for the Tritium Processing Laboratory at the Japan Atomic Energy Research Institute's Tokai Research Establishment. Construction on this new facility is scheduled to begin in April 1983. This facility will be the center for fusion tritium technology development in Japan. The European Community is currently working on the design of the tritium facility for the Joint European Torus. There is considerable interaction between all of these programs, thus accelerating the overall development of this crucial technology.

10779 **Viability of the $^{11}B(p, \alpha)\ 2\alpha$ cycle.** Gordon, J.D.; Samec, T.K. (TRW Energy Development Group, One Space Park, R1/2128, Redondo Beach, CA 90278). *Nuclear Technology/Fusion;* 4: No. 2, 348-352(Sep 1983). (CONF-830406—).

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The authors evaluated the energetics of the proton^{11}boron advanced fuel fusion cycle and found that the enhancement of reactivity obtained from non-thermal mechanisms is significantly less than the enhancement required for ignition or high gain operation. Based on a detailed calculation of synchrotron radiation losses, at least 135% enhancement of the reactivity is needed for ignition. The direct and induced radioactivity associated with the cycle, while being orders of magnitude lower than that of D-T, is not negligible and requires serious attention in the design. Thus, it is concluded that, using present physics knowledge, the p-^{11}B cycle is not viable for commercial fusion power.

10780 **On the development of accident sequences involving tokamak impurity control systems.** Madrid, A.; Apostolakis, G. (Univ. of California, School of Engineering and Applied Science, Los Angeles, CA 90024). *Nuclear Technology/Fusion;* 4: No. 2, 1135-1140(Sep 1983). (CONF-830406—).

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A set of initiating events are identified and the associated accident sequences are developed for impurity control systems in tokamak fusion reactors. The master logic diagram concept used in risk analysis is developed for a tokamak. The notion of the fusion island is used as the central power producing element in fusion power plants. Differences in the severity of initiating events and/or accident sequences that are associated with the two leading candidate impurity control concepts, the pump limiter and the poloidal divertor, are identified. They reflect both safety-related and/or financial consequences.

10781 **Cost optimization of tritium control systems.** Holland, D.F. (EG and G Idaho, Inc. P.O. Box 1625, Idaho Falls, ID 83415). *Nuclear Technology/Fusion;* 4: No. 2, 1127-1130(Sep 1983). (CONF-830406—).

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In the future, control systems will be needed to reduce tritium levels in the primary coolant and reactor building of water cooled fusion devices. This paper presents a method to determine the size and configuration of the control system required to meet federal regulations including the as low as reasonably achievable (ALARA) guideline. A cost expression is developed that includes a cost for population exposure based on an ALARA guide (cost/man-rem). The optimum configuration and resulting tritium levels are determined by optimizing the cost expression. Application is made to an ETR/INTOR class of fusion reactor.

10782 **Instrumentation and safety controls for tandem mirror fusion reactors.** Youssef, M.Z. (Fusion Engineering and Physics Program, School of Engineering and Applied Science, Univ. of California at Los Angeles, Los Angeles CA 90024). *Nuclear Technology/Fusion;* 4: No. 2, 1479-1485(Sep 1983). (CONF-830406—).

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In the present study the authors identified some key parameters that require continuous measurement by the instrumentation and control system to assure safe operation in tandem mirror reactors. Failure modes possible in each subsystem of the plant have also been identified. Particular emphasis was placed on the heat transport and flux monitoring systems. In addition, general factors to be considered in the design and the performance requirements of the plant instrumentation and control system are outlined.

10783 **Tritium recovery from liquid lithium-lead by vacuum degassing.** Plute, K.E.; Larsen, E.M. (Univ. of Wisconsin, Dept. of Chemistry, 1101 University Avenue, Madison, WI 53706). *Nuclear Technology/Fusion;* 4: No. 2, 407-411(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Various techniques for tritium removal from the liquid eutectic $Li_{17}Pb_{83}$ under vacuum are considered as candidates for the tritium removal system (TRS) for the Mirror Advanced Reactor Study (MARS). The TRS baseline parameters require the removal of 60% of the tritium contained in the liquid metal at a tritium partial pressure of 1.0×10^{-4} torr (0.013 Pa). Degassing from a droplet spray was chosen as the preferred design option, although removal from thin films is a feasible alternative. Vacuum removal from a stirred pool was rejected because of the size and relatively poor transport conditions. The use of an inert purge gas was also rejected due to the large purge gas flow rate and the problem of separating tritium from a large quantity of inert gas.

10784 **Risk considerations for fusion energy.** Kazimi, M.S. (Massachusetts Inst. of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139). *Nuclear Technology/Fusion;* 4: No. 2, 527-532(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

An assessment is made of the public and occupational health effects implied in the utilization of fusion reactors as a source of electricity. Three conceptual designs for TOKAMAK fusion reactors are used in the assessment. It was assumed in this analysis that a fusion plant will release 10 Ci/day of tritium to the atmosphere. Risk from waste management and accidents are estimated relative to risk of LWR's energy cycle. Comparison of the fusion occupational and public risk from coal, LWR, solar thermal and solar-photovoltaic plants has been undertaken. It is concluded that, compared to other fuel cycles, fusion can potentially have a favorable position with respect to risk.

10785 **Assessments of tritium breeding requirements and breeding potential for the STARFIRE/DEMO design.** Jung, J.; Abdou, M. (Fusion Power Program, Argonne National Lab., Argonne, IL 60439). *Nuclear Technology/Fusion;* 4: No. 2, 361-366(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

This paper presents assessments of tritium breeding requirements and breeding potential for the STARFIRE/DEMO design. The assessment of breeding requirement is described based on two design considerations; i.e., (1) tritium inventory and doubling requirement; and (2) computational uncertainties associated with the breeding calculation. The lithium-containing materials considered include: solid Li_2O and $LiAlO_2$ and liquid lithium and 17Li-83Pb.

10786 **Software design for the Tritium Systems Test Assembly.** Claborn, G.W.; Keaphy, R.T. (Los Alamos National Lab., Los Alamos, NM 87545). *Nuclear Technology/Fusion;* 4: No. 2, 1497-1502(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The control system for the Tritium Systems Test Assembly (TSTA) must execute complicated algorithms for the control of several sophisticated subsystems. It must implement this control with requirements for easy modifiability, for high availability, and provide stringent protection for personnel and the environment. Software techniques used to deal with these requirements are described, including modularization based on the structure of the physical systems, a two-level hierarchy of concurrency, a dynamically modifiable manmachine interface, and a specification and documentation language based on a computerized form of structured flowcharts.

10787 **Tritium monitoring within the reactor hall of a DT fusion reactor.** Jalbert, R.A. (Los Alamos National Lab., Los Alamos, NM 87545). *Nuclear Technology/Fusion;* 4: No. 2, 112-115(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Monitoring the reactor hall atmosphere of DT-fueled fusion reactors will probably be performed with conventional ion chamber and proportional counter instruments modified as necessary to deal with the background radiation. Background includes external neutron and gamma radiation and internal beta-gamma radiation from the activated atmosphere. Although locating instruments in remote areas of the reactor hall and adding local shielding and electronic compensation may be feasible, placing the instruments in accessible low-background areas outside of the reactor hall and doing remote sampling is preferable and solves most of the radiation problems. The remaining problem of the activated atmosphere may be solved by recently developed instruments in conjunction with the use of semi-permeable membranes currently under development and evaluation.

10788 **Radiation catalyzed conversion of tritium gas to tritiated water.** Easterley, C.E.; Bennett, M.R. (Health and Safety Research Division, Oak Ridge National Lab., Oak Ridge, TN 37830). *Nuclear Technology/Fusion;* 4: No. 2, 116-120(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A survey of water production dependence on tritium concentration and external radiation fields has been made for the tritium-in-air concentration range of 0.01 to 1 Ci/m^3. Results of reactions taking place under static conditions (in Pyrex flasks at 20°C) indicate that: (1) self-catalyzed rates may be first order-dependent on tritium concentration, and (2) external radiation fields may cause a virtual steady-state condition to occur (in terms of additional self-catalyzed water production).

10789 **Tritium removal from contaminated water via infrared laser multiple-photon dissociation.** Maienschein, J.L.; Magnotta, F. (Univ. of California, Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA 94550). *Nuclear Technology/Fusion;* 4: No. 2, 121-126(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Isotope separation by means of infrared-laser multiple-photon dissociation offers an efficient way to recover tritium from contaminated light or heavy water found in fission and fusion reactors. For tritium recovery from heavy water, chemical exchange of tritium into deuterated chloroform is followed by selective laser dissociation of tritiated chloroform and removal of the tritiated photoproduct, TCl. The single-step separation factor is at least 2700 and is probably greater than 5000. Here we present a description of the tritium recovery process, along with recent accomplishments in photochemical studies and engineering analysis of a recovery system.

10790 **Safety analysis report for the Tritium Systems Test Assembly.** Carlson, R.V. (Los Alamos National Lab., Los Alamos, NM 87544). *Nuclear Technology/Fusion;* 4: No. 2, 544-549(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

One of the primary objectives of the Tritium Systems Test Assembly is to demonstrate that the technologies associated with the DT fuel cycle for a fusion reactor can be operated safely and operated with minimal environmental impact. During the design and construction phase, safety analyses were performed to investigate the effects of normal operations, of component failure, of operational failures, and of failures induced by natural phenomena. The effects on operation personnel, the general public and the environment were determined. Major releases of tritium were found to be highly improbable ($<10^{-6}$/year) since they require a compound failure of primary and secondary containment, along with either a breach of the building or a failure of the room cleanup system. The effects from normal operations and high probability failures were also determined to be minimal.

10791 **Environment and safety major goals for MARS.** Maninger, R.C. (Lawrence Livermore National Lab., P.O. Box 5511, L-644, Livermore, CA 94550). *Nuclear Technology/Fusion;* 4: No. 2, 550-554(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The Mirror Advanced Reactor Study (MARS) is a conceptual design study for a commercial fusion power reactor. One of the major goals of MARS is to develop design guidance so that fusion reactors can meet reasonable expectations for environmental health and safety. One of the first steps in the assessment of health and safety requirements was to examine what the guidelines might be for health and safety in disposal of radioactive wastes from fusion reactors. Then, using these guidelines as criteria, the impact of materials selection upon generation of radioactive wastes through neutron activation of structural materials was investigated. A conclusion of this work is that fusion power systems may need substantial engineering effort in new materials development and selection to meet the probable publicly acceptable levels of radioactivity for waste disposal in the future.

10792 **Design considerations for direct illumination - driven inertial fusion reactors.** Hovingh, J. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA 94550). *Nuclear Technology/Fusion;* 4: No. 2, 973-978(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

This study parametrically examines the implications on inertial fusion reactor design of the use of direct drive pellets as an alternative to the radiation-driven targets. We have examined the impacts of direct illumination on mirror damage constraints, reactor neutronic performance, and system energetics and cost. The capital costs for low f/number, direct-illuminationdriven inertial fusion power plants are required to be significantly less than those for the radiation-driven or high f/number direct illumination driven power plants to produce electricity at the same cost.

10793 **Fluidized bed design for ICF reactor blankets using solid lithium compounds.** Sucov, E.W.; Malick, F.S. (Westinghouse Electric Corp., Madison, PA 15663). *Nuclear Technology/Fusion;* 4: No. 2, 1084-1088(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A fluidized bed concept for blankets of dry or wetted first wall ICF reactors using solid lithium compounds is described. The reaction chamber is a right cylinder, 32 m high and 20 m in diameter; the blanket is composed of 36 steel tanks, 32 m high, which carry the sintered Li_2O particles in the fluidizing helium gas. Each tank has a radial thickness of 2 m which generates a tritium breeding ratio (TBR) of 1.27 and absorbs over 98% of the neutron energy; reducing the thickness to 1.2 m produces a TBR of 1.2 and energy absorption of 97% which satisfy the design goals. Calculations of tritium diffusion through the grains and heat removal from the grains showed that neither could be removed by the carrier gas; tritium and heat are therefore removed by removing the grains continuously. The particles are continuously fed into the bottom of the tanks at 300°C and removed at the top at 475°C. Tritium and heat extraction are easily and conveniently done outside the reactor. Compared to blanket designs which use flowing liquid metals or packed beds of solid lithium compounds, this concept is safer, simpler, cheaper, easier to maintain and less likely to break down. In addition, this concept is compatible with both wetted wall and dry wall first wall designs. Finally, deleterious thermal expansion effects due to absorption of the neutron pulse in liquid lithium or the packed bed disappear because of the decoupling of the particles in the helium stream.

10794 **High performance breeding blankets for ICF facilities.** Larson, A.R.; Bohachevsky, I.O. (Los Alamos National Lab., P.O. Box 1663, US F611, Los Alamos, NM 87545). *Nuclear Technology/Fusion;* 4: No. 2, 1245-1250(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Discussed are the advantages of using fusion neutrons for breeding special nuclear materials and tritium. Monte Carlo calculations were used to identify both fissionable and nonfissionable materials that multiply neutrons and increase breeding ratios. Fissionable multipliers also greatly multiply the neutron energy. A generic blanket design that utilizes ^{238}U as a neutron multiplier is described and compared to an ideal infinitemedium blanket. Time-dependent calculations show gradual improvement of performance during the lifetime of the blanket. The blanket analyzed here is compatible with a reaction chamber that uses high velocity lithium, held on the wall by centrifugal acceleration, to protect the wall from pellet explosions.

10795 **Inertial fusion program-present status.** Kahalas, S.L. (US Dept. of Energy, Office of Inertial Fusion, Washington, DC 20545). *Nuclear Technology/Fusion;* 4: No. 2, 3-5(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The present status of the inertial fusion program is reviewed. The program has two major applications, one to military areas, the other to longterm energy needs. The near-term program is described by a 5-year program plan that coordinates research and culminates in a 1987 decision. The near-term program strategy is to build and operate the three new large facilities, ANTARES, NOVA, and PBFA II in order to maximize the physics data base needed to evaluate the drivertarget requirements for ignition and higher gain. Low-cost driver technology will also play an important role in the 1987 program decision. Depending on the outcome of this decision, there is a succession of archetypical facilities and associated systems studies necessary to achieve goals for long-term energy needs through inertial fusion. These are briefly discussed.

10796 **The development of the mirror advanced reactor study (MARS) end plasma technology system.** Kerbermann, R.; Calia, V. (Grumman Aerospace Corp., Bethpage, NY 11714). *Nuclear Technology/Fusion;* 4: No. 2, 279-283(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

An End Plasma System was designed for the MARS tandem mirror reactor. This includes an electrostatic direct converter, a halo plasma scraper, a vacuum pumping system, and a vacuum enclosure. The converter recovers 327 MW of electrical power and absorbs 239 MW of thermal power from the charged particle energy in the plasma fans. The system provides the vacuum pumping necessary to remove the helium ash, accompanying fuel ions, and impurities present in the reactor. It also provides a means to control the central cell plasma potential relative to the first wall.

10797 **Preliminary analysis of a carbon/carbon fiber composite plasma direct converter.** Gurol, H.; Shuy, G.W. (Science Applications, Inc., P.O. Box 2351, La Jolla, CA 92038). *Nuclear Technology/Fusion;* 4: No. 2, 1473-1478(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The feasibility of a PDC that uses radiatively cooled grids and collector plate made of carbon/carbon fiber composite is presented. Elimination of the coolant makes a thin grid design possible. The advantages are increased direct conversion efficiency, no tritium permeation into grid tube coolant, and compact design.

10798 **The Fusion Materials Irradiation Test (FMIT) facility lithium system - A design and development status.** Brackenbury, P.J. (Westinghouse Hanford Company, P.O. Box 1970, Richland, WA 99352). *Nuclear Technology/Fusion;* 4: No. 2, 724-729(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The design and development of the Fusion Materials Irradiation Test (FMIT) Facility lithium system is outlined. This unique liquid lithium recirculating system, the largest of its kind in the world, is described with emphasis on the liquid lithium target assembly and other important components necessary to provide lithium flow to the target. The operational status and role of the Experimental Lithium System (ELS) in the design of the FMIT lithium system are discussed. Safety aspects of operating the FMIT lithium system in a highly radioactive condition are described. Potential spillage of the lithium is controlled by cell liners, by argon flood systems and by remote maintenance features. Lithium chemistry is monitored and controlled by a sidestream loop, where impurities measured by instruments are collected by hot and cold traps.

10799 **A fission-based, distributed, 14 MeV fusion neutron radiation source for first wall/blanket component testing and system development.** Hsu, P.Y.; Miller, L.G. (EG and G Idaho, Inc./Fusion Technology, P.O. Box 1625, Idaho Falls, ID 83415). *Nuclear Technology/Fusion;* 4: No. 2, 1216-1221(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A large-volume, distributed, pulsed, 14 MeV neutron source, which utilizes the high powered (270-GW) Power Burst Facility (PBF) at the Idaho National Engineering Laboratory, is described. The concept of utilizing existing fission test reactors to test fusion first wall/blanket (FW/B) components and systems has been adequately documented. In all previous scenarios, the normal fission spectrum (including tailoring) was shown to produce adequate heating profiles and some tritium breeding. However, one recognized shortcoming has been the absence of the 14 MeV neutron component. This paper describes a scheme whereby the fission neutrons would be employed to produce the desired 14 MeV component. The data obtained from tests in this largevolume (20 cm (8 in.) in diameter and 90 cm (36 in.) in length), distributed neutron source will pertain to both near-term (Tokamak Fusion Test Reactor--TFTR) and future pulsed fusion machines. Specifically, application requiring high flux but low fluence is foreseen in the areas of dosimetry benchmarking for tritium breeding performance code verification. As a general purpose, FW/B integrated technology development capability, the PBF is shown to be pertinent to addressing the bulk-heated, solid breeder blanket thermal and mechanical issues; tritium permeation in the presence of radiation, and barrier development in the prototypical radiation environment associated with the first wall; issues associated with the technology of breeder materials; and in-situ tritium recovery process characterization and system development.

10800 **Low activation fusion reactor design studies.** Hopkins, G.R.; Cheng, E.T. (GA Technologies Inc., P.O. Box 85608, San Diego, CA 92138). *Nuclear Technology/Fusion;* 4: No. 2, 1251-1256(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A design study for a low activation tokamak fusion reactor based on the STARFIRE baseline design has been done. The major components of limiter, first wall, blanket, shield and toroidal field coils have all been designed with very low activation materials and the designs appear technically achievable. The result provides a fusion power reactor with a high degree of direct personnel access for maintenance and repair, with a large reduction in safety and environmental impact, and with much reduced waste disposal problems. This low activation design also appears economically attractive and is expected to have a high degree of public acceptance.

10801 **Electromagnetic effects on the FED/INTOR limiter.** Turner, L.R.; Foss, M.H. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439). *Nuclear Technology/Fusion;* 4: No. 2, 459-464(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

Electromagnetic effects were among the critical issues of the impurity control system examined in the 1982 FED/INTOR design study. During a plasma disruption, the decaying plasma current induces voltages and currents in the first wall and limiter systems which can produce arcing between limiter segments and large forces and torques on the limiter. The effects of first wall time constant, limiter electrical resistance, and limiter segmentation on the voltages, forces, and torques were studied.

10802 **Remote vacuum joint concept for fusion reactors.** Doll, D.W.; Hager, E.R. (GA Technologies, Inc., P.O. Box 85608). *Nuclear Technology/Fusion;* 4: No. 2, 218-223(Sep 1983). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

A remotely operable vacuum duct joint has been designed by GA Technologies, Inc. The concept is applicable to large rectangular vacuum ducts, many of which are required on advanced fusion devices. The duct size chosen for this design is 1m X .4m although it may be scaled up or down for other applications. Shaft driven mechanical linkages provide a large axial force against one flange which is reacted by latch mechanisms that engage the mating flange. Drive shafts are actuated by an impact wrench handled by a remote manipulator. Remote disassembly time is about 3 hours.

10803 **Design of the ELMO Bumpy Torus Proof-of-Principle device.** Glowienka, J.C. (Oak Ridge National Lab., TN (USA)). pp v.1 p.181-186 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. 2 v. Oxford ,UK.; Pergamon Press (1983). (CONF-820948—).

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound125.00.

The ELMO Bumpy Torus Proof-of-Principle device, EBT-P, is a major scale up of all device parameters from the existing EBT-S experiment. This device is intended to yield sufficient information on critical issues to establish the validity of the EBT concept.

10804 **INTOR impurity control and first wall system.** Abdou, M.A. (Argonne National Lab., IL (USA)). pp v.1 p.39-56 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. 2 v. Oxford ,UK.; Pergamon Press (1983). (CONF-820948—).

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound125.00.

The highlights of the recent INTOR effort on examining the key issues of the impurity control/first wall system are summarized. The emphasis of the work was an integrated study of the edge-region physics, plasma-wall interaction, materials, engineering and magnetic considerations associated with the poloidal divertor and pump limiter. The development of limiter and divertor collector plate designs with an acceptable lifetime was a major part of the work.

10805 **Demonstration tokamak power plant.** Abdou, M.; Baker, C.; Brooks, J.; Ehat, D.; Mattas, R.; Smith, D. (Argonne National Lab., IL (USA)); DeFreece, D.; Morgan, G.D.; Trachsel, C. (McDonnell Douglas Astronautics Co., St. Louis, MO (USA)). pp v.1 p.609-621 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. 2 v. Oxford ,UK.; Pergamon Press (1983). (CONF-820948—).

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound125.00.

A design study of a tokamak-based fusion demonstration reactor was carried out. The study focused on four critical design features: 1) current drive for steady-state operation, 2) impurity control and exhaust, 3) breeding blanket, and 4) reactor configuration and maintenance.

10806 **Neutronic implications of lead-lithium blankets.** Meier, W.R. (Lawrence Livermore National Lab., CA (USA)). pp v.1 p.649-654 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. 2 v. Oxford ,UK.; Pergamon Press (1983). (CONF-820948—).

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound125.00.

Lead-lithium alloys have been proposed for use in several conceptual blanket designs for both inertial and magnetic confinement fusion reactors. In most cases, $Pb_{83}Li_{17}$, a eutectic with a melting point of 235°C, is the chosen composition. The primary reasons for using $Pb_{83}Li_{17}$ instead of Li as the tritium breeding material are the perceived safety advantages, low tritium solubility, and favorable neutronic characteristics. A description is given of the neutronic characteristics of $Pb_{83}Li_{17}$ blankets with emphasis on the enhanced neutron leakage through chamber ports and the degradation in blanket performance parameters that occurs as a result of the enhanced leakage.

10807 **Design and fabrication of the superconducting magnet system for the mirror fusion test facility (MFTF-B).** Tatro, R.E.; Wohlwend, J.W. (General Dynamics/Convair, San Diego, CA (USA)); Kozman, T.A. (Lawrence Livermore National Lab., CA (USA)). pp v.1 p.167-173 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. 2 v. Oxford ,UK.; Pergamon Press (1983). (CONF-820948—).

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound125.00.

The superconducting magnet system for the Mirror Fusion Test Facility (MFTF-B) consists of 24 magnets; i.e. two pairs of C-shaped Yin-Yang coils, four C-shaped transition coils, four solenoidal axicell coils, and a 12-solenoid central cell. General Dynamics Convair Division has designed all the coils and is responsible for fabricating 20 coils. The two Yin-Yang pairs (four coils) are being fabricated by the Lawrence Livermore National Laboratory. Since MFTF-B is not a magnet development program, but rather a major physics experiment critical to the mirror fusion program, the basic philosophy has been to use proven materials and analytical techniques wherever possible. The transition and axicell coils are currently being analyzed and designed, while fabrication is under way on the solenoid magnets.

10808 **Generation of synchronous AC power through magnetic field compression.** Denno, K. (New Jersey Inst. of Tech., Newark (USA). Electrical Engineering Dept.). pp 105-113 of Alternative Energy Sources V. Part E: Nuclear/Conservation/Environment. Proceedings of the fifth Miami International Conference held at Miami Beach, Florida, December 13-15, 1982. Veziroglu, T.N. (Miami Univ., Coral Gables, FL (USA). Clean Energy Research Inst.) (ed.). Amsterdam ,Netherlands.; Elsevier (1983). (CONF-821213—).

From 5. international conference on alternative energy source; Miami Beach, FL, USA (13 Dec 1982).

This paper presents conceptual analytical design picture for the MHD-synchronous AC generator using an accelerated plasma from the divertor of the fusion reactor plant. The exhaust plasma of the fusion reactor usually at low level in pressure and velocity will be accelerated through the action of any model of the linear induction accelerators. Structural components of the synchronous-MHD generator comprises co-axial perfectly conducting cylinders with the inner cylinder having a set of lateral tangential blades whose function is to impart the rotor with the desired mechanical velocity for synchronous operation, from the impinging plasma. Electric AC power will be developed through induction in a sinusoidally distributed three phase conventional winding close to the inner cylinder. Magneto-fluid interaction solutions as well as electro-mechanical outcome power expressions have been secured for actual concept design.

10809 **Linear acceleration of exhaust plasma in a fusion power plant.** Denno, K. (New Jersey Inst. of Tech., Newark (USA). Electrical Engineering Department). pp 115-124 of Alternative Energy Sources V. Part E: Nuclear/Conservation/Environment. Proceedings of the fifth Miami International Conference held at Miami Beach, Florida, December 13-15, 1982. Veziroglu, T.N. (Miami Univ., Coral Gables, FL (USA). Clean Energy Research Inst.) (ed.). Amsterdam ,Netherlands.; Elsevier (1983). (CONF-821213—).

From 5. international conference on alternative energy source; Miami Beach, FL, USA (13 Dec 1982).

9 refs.

This paper presents design concepts regarding various modes of accelerators considered compatible for accelerating the low velocity, low pressure exhaust plasma of the fusion reactor divertor. Based on a review of several types of linear induction accelerators, namely, the core types and the pulse line types, expressions have been obtained for the accelerating electric fields which could be subjected on the MHD channel housing the exhaust plasma. From solutions obtained in this paper representing concentration distribution functions for He^{+} and He^{++} as well as neutrals for the divertor plasma, expressions for the linear accelerations have been established along the MHD channel flow in the steady state mode. And finally, solutions for conceptual performance parameters for the MHD-Induction, AC power generators are presented.

10810 **Pre-operational testing of TFTR systems.** Goldfarb, S.; Ward, C.O. (Princeton Univ., NJ (USA). Plasma Physics Lab.). pp v.1 p.291-295 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. 2 v. Oxford ,UK.; Pergamon Press (1983). (CONF-820948—).

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound125.00.

The Tokamak Fusion Test Reactor (TFTR) is composed of 21 major systems, all of which must function in order to meet project objectives. To assure adequate, timely and reliable function of these systems, a sequence of tests is planned for various levels of assembly. The test sequence is keyed to initial operational phases. Additional tests are planned for later operational phases leading to full power performance with deuterium and tritium. The overall test sequence is intended to expose design and fabrication problems as early as possible for corrective action to minimize impact on the schedule. Operational tests begin at low power levels and progress in steps to design levels while critical parameters are monitored. The sequence of tests required to meet the goals of initial TFTR operation is described.

10811 **Power supply and protection system for the extraction grid of the JET neutral injectors.** Aslin, H.; Groll, W.K.; Hartline, R.T. (RPC Industries, Hayward, CA (USA)); Ciscato, D. (Euratom/UKAEA Fusion Association, Abingdon (UK). Culham Lab.); Hrabal, D. (Siemens A.G., Erlangen (Germany, F.R.)). pp v.1 p.391-397 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. 2 v. Oxford ,UK.; Pergamon Press (1983). (CONF-820948—).

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound125.00.

A description is given of the power supply and protection system for the extraction grid of the JET neutral injectors.

10812 **High voltage control and protection system for the Culham multimegawatt beam line.** Hicks, J.B.; Gascoyne, P.F.; Hammond, D.P.; Hay, J.H.; Pedley, T.R. (Euratom/UKAEA Fusion Association, Abingdon (UK). Culham Lab.); Hartline, R.E.; Groll, W.K. (R P C Industries, Hayward, CA (USA)). pp v.1 p.419-424 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. 2 v. Oxford ,UK.; Pergamon Press (1983). (CONF-820948—).

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound125.00.

A new HV control and protection system has been installed on the Megawatt Beam Line at Culham, to permit the testing of JET prototype injector modules at 80kV and 60A, for pulses of up to 5 s duration. A HV tetrode is connected in series with the HV power supply and is used both to control the pulse voltage profiles and to provide fast protection for the injector. The system is described and evidence of its successful operation, obtained during both dummy load tests and initial tests of a prototype module, is examined.

10813 **The effects of tritium contamination in the FED/INTOR reactor hall.** Finn, P.A.; Rogers, M.L. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439). *Nuclear Technology/Fusion;* 4: No. 2, 99-105(Sep 1982). (CONF-830406—).

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

The purpose of this study was to determine the constraints imposed on the FED/INTOR fusion plants by tritium contamination in the reactor hall. Limitations imposed by gamma radiation levels and the maintenance philosophy adopted were included. The cost (capital and operating) required to maintain 5, 50 and 500 $\mu Ci/m^3$ was evaluated. Three different maintenance strategies (unsuited worker, suited worker and robotics) were studied to determine if tritium contamination placed a constraint on reactor availability.

99 GENERAL AND MISCELLANEOUS

9901 Management

10814 **(EGG-M—08384) Configuration management development and implementation at a multi discipline nuclear research facility.** Freed, B.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 11p. (CONF-8409189—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003402.

From Nuclear records management symposium; Nashville, TN, USA (10 Sep 1984).

This paper describes the development and implementation of a configuration management system for a major company at the Idaho National Engineering Laboratory.

10815 **(LA-UR—84-3537) Intel iDIS evaluation.** Cheadle, J.M.; Glassmire, M.B. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 7p. (CONF-8411114—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003748.

From Association of System 2000 Users for Technology Exchange conference (ASTUTE); Hilton Head, SC, USA (11 Nov 1984).

This paper describes an evaluation of a computer system called the Intel Database Information System (iDIS), which was recently performed at the Los Alamos National Laboratory. The evaluation consisted of the development of a possible application for the Compensation and Benefits Section of the Personnel Administration Division at Los Alamos.

9902 Mathematics And Computers

10816 **(ANL—84-83) Second thoughts on the mathematical software effort: a perspective.** Cody, W.J. (Argonne National Lab., IL (USA)). Oct 1984. Contract W-31-109-ENG-38. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004831.

The mathematical software effort bridges the gap between the discovery of numerical algorithms and the consumption of numerical software. The spectrum of activities is surprisingly wide, including tasks often associated with numerical analysis, program design and testing, programming practices, language standards, documentation standards, software organization, distribution methods, and even the specification of arithmetic engines. This paper highlights the most important accomplishments in the field over the last twenty years. It also examines current problems and future challenges posed by the rapid advance of technology.

10817 **(LA—10208-M) EZPIX: a tablet entry method for computer-generated slides, drawings, and graphs.** Williams, J.M. (Los Alamos National Lab., NM (USA)). Sep 1984. Contract W-7405-ENG-36. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85005234.

This manual outlines a method for making slides, drawings, maps, graphs, etc., with the touch of a button. A minicomputer-based program, called EZPIX, connects the host computer graphics system to a tablet on which one can digitize input and specify graphics commands from a menu. A minicomputer terminal serves as editor and provides local graphics output. The magic button does practically everything else. It signs you on, starts, builds, ends, executes and saves your command file, and signs you off. It even allows you to make a composite picture from an assortment of inappropriately sized originals. The graph and pie chart modes are handy, too.

10818 **(UCRL—91734) Exploiting multiprocessors: issues and options.** McGraw, J.R.; Axelrod, T.S. (Lawrence Livermore National Lab., CA (USA)). 31 Oct 1984. Contract W-7405-ENG-48. 24p. (CONF-8411126—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003144.

From Code developers conference; San Diego, CA, USA (6 Nov 1984).

This paper examines problems involved in moving applications programs to multiprocessors and outlines strategies currently being considered to resolve these problems. We first identify problems encountered in programming the HEP and Cray X-MP multiprocessors and explain why these problems are likely to exist on any of the multiprocessors available for use at the national laboratories. We then survey a spectrum of possible approaches and identify the costs and remaining research issues associated with each. The bottom line is that we do not currently have any easy solutions; significant planning must begin now if we are to effectively use these new systems.

10819 **System architecture of a reconfigurable multimicroprocessor research system.** Trujillo, V.A. (Computing Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). pp 350-352 of Proceedings of the 1982 International Conference on Parallel Processing. Los Angeles, CA, USA; IEEE Computer Society (1982). (CONF-820829—).

From International conference on parallel processing; Bellaire, MI, USA (24 Aug 1982).

This paper presents the architecture of an experimental multiprocessor system that incorporates a reconfigurable array of microprocessing and memory elements. The system is designed specifically as a research tool for implementing and evaluating parallel-processing algorithms on various multiprocessor architectures. Consequently, the principal design objective is to provide a multiprocessor with fully reconfigurable processor-to-memory and processor-to-processor interconnections in order to allow direct comparison of algorithms for a wide range of multiprocessor architectures. Basically, the system is a tightly coupled, shared-memory MIMD machine that supports reconfiguration between processor and memory nodes to permit experimentation with common memory architectures and with various processor network structures such as rings, trees, and stars. This experimental computer system is currently under development within the Computing Division at Los Alamos National Laboratory.

10820 **A test strategy for packet switching networks.** Lim, W.Y. (Laboratory for Computer Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). pp 96-98 of Proceedings of the 1982 International Conference on Parallel Processing. Los Angeles, CA, USA; IEEE Computer Society (1982). (CONF-820829—).

From International conference on parallel processing; Bellaire, MI, USA (24 Aug 1982).

A test strategy for packet switching networks is described. The effect of a single stuck-at fault is either misdirected packets, missing packets, corrupted data in packets, or multiple packets. A fault can either prevent packet transmission or affect the integrity of the data sent in the packet and it is detected as one of 4 cases – both output ports of the switching element inaccessible to an input

port, an output port inaccessible to an input port, an input port permanently connected to an output port and erroneous packet length.

10821 **Function sharing in a static data flow machine.** Todd, K.W. (Laboratory for Computer Science, Massachusetts Institute of Technology, Cambridge, MA 02139). pp 137-139 of Proceedings of the 1982 International Conference on Parallel Processing. Los Angeles, CA, USA; IEEE Computer Society (1982). (CONF-820829—).

From International conference on parallel processing; Bellaire, MI, USA (24 Aug 1982).

Sharing a single copy of the body of a function among its invocation points in a program has been an important means of keeping down the size of large programs and thus enabling them to run on conventional computers. To do the same for programs run on a static data flow machine is also desirable but not easy because of the nature of the machine. This paper presents a scheme at the machine level of a static data flow machine for sharing a function among its activation sites which can be further modified to accommodate a variety of constraints. For programs using this scheme, space consumption is reduced but at the cost of an increased execution time.

10822 **Algorithms for replace-add based paracomputers.** Kruskal, C.P. (Department of Computer Science, University of Illinois, Urbana, Illinois 61801). pp 219-223 of Proceedings of the 1982 International Conference on Parallel Processing. Los Angeles, CA, USA; IEEE Computer Society (1982). (CONF-820829—).

From International conference on parallel processing; Bellaire, MI, USA (24 Aug 1982).

Several groups are designing large-scale multiprocessors to take advantage of inexpensive, fast floating-point processors which will soon be available. One such project is the "NYU Ultracomputer" for which much effort has gone into designing operating system algorithms, and designing and implementing numerical algorithms. In this paper the authors present and analyze algorithms for solving nonnumerical problems on an idealized model of the Ultracomputer -a "replace-add-based paracomputer". A replace-add-based paracomputer is essentially a traditional shared memory machine augmented with an extra primitive -- the "replace-add". By exhibiting algorithms that make use of the replace-add to be faster than any algorithm for solving the same problem on a traditional shared memory machine, they show that this primitive enhances the model.

10823 **Results of parallel processing a large scientific problem on a commercially available multiple-processor computer system.** Hiromoto, R. (Computing Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). pp 243-244 of Proceedings of the 1982 International Conference on Parallel Processing. Los Angeles, CA, USA; IEEE Computer Society (1982). (CONF-820829—).

From International conference on parallel processing; Bellaire, MI, USA (24 Aug 1982).

Presented is a summary of a parallelprocessing experiment designed to study the feasibility of doing large-scale scientific calculations on multiple-processor architectures. This particular experiment was performed on a UNIVAC 1100/80 computer system, whose architecture (configured about a common memory) eliminates the need for data transmission between processors. The algorithm used in the experiment is a particle-incell (PIC) method; it was selected because of its large, independent computational tasks that are adaptable to this particular parallel-processing architecture. Timing results for the parallelprocessing version of this algorithm using one, two, three, and four identical processors are given and are shown to have promising speedup times when compared to the overall run times measured for a single processor version of the algorithm.

10824 **A fault tolerant interconnection network using error correcting codes.** Lilienkamp, J.E.; Lawrie, D.H.; Yew, P.C. (Department of Computer Science, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). pp 123-125 of Proceedings of the 1982 International Conference on Parallel Processing. Los Angeles, CA, USA; IEEE Computer Society (1982). (CONF-820829—).

From International conference on parallel processing; Bellaire, MI, USA (24 Aug 1982).

A method for constructing a fault tolerant interconnection network is described. It uses error correcting codes to correct errors due to all single and many multiple failures of both switching elements and links, and requires O(Nw) encoders and decoders, where N is the network size and w is the size of the packet in bits, and less than w additional check bits. Also discussed is a method for isolating the failed component after one is detected. This result contrasts with previous results because it allows the network to continue operation while the fault is being located, rather than performing off-line testing.

10825 **New algorithm for the reliability analysis of multiterminal networks.** Satyanarayana, A.; Hagstrom, J.N. (Univ. of California, Berkeley). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Reliability;* **R-30**: No. 4, 22-31(Oct 1981).

In a probabilistic network, source-to-multiple-terminal reliability (SMT reliability) is the probability that a specified vertex can reach every other vertex. A new topological formula for the SMT reliability of probabilistic networks. The formula generates only non-cancelling terms. The non-cancelling terms in the reliability expression correspond one-to-one with the acyclic t-subgraphs of the network. An acyclic t-subgraph is an acyclic graph in which every link is in at least one spanning rooted tree of the graph. The sign to be associated with each term is easily computed by counting the vertices and links in the corresponding subgraph. Overall reliability is the probability that every vertex can reach every other vertex in the network. For an undirected network, it is shown the SMT reliability is equal to the overall reliability. The formula is general and applies to networks containing directed or undirected links. Furthermore link failures in the network can be s-dependent. An algorithm is presented for generating all acyclic t-subgraphs and computing the reliability of the network. The reliability expression is obtained in symbolic factored form.

10826 **Reliability evaluation of a flow network.** Lee, S.H. (North Carolina State Univ., Raleigh). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Reliability;* **R-29**: No. 1, 42-44(Apr 1980).

A method is presented for evaluating reliability of a flow network using the concept of lexicographic ordering. Associated with each branch of the network are the flow capacity and the probability that the branch functions properly. The network is successful if a specified unit of flow can be transmitted through the network. A labeling scheme is used to route the flow through the network and a computer program for implementing the algorithm is given in the supplement.

9903 Information Handling

REFER ALSO TO CITATION(S) 99030010815

10827 **(EGG-IS—6494(6-84)) INEL User Network Exchange. Vol. 6-84, Nov./Dec. 1984.** Williams, T.L. (ed.). (EG and G Idaho, Inc., Idaho Falls (USA)). [1985]. Contract AC07-76ID01570. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004694.

This newsletter includes items of general interest to the INEL User Network. (GHT)

10828 **(LBL—18504) Requirements for a database management system.** Lawrence, J.D.; McCarthy, J. (Lawrence Berkeley Lab., CA (USA)). Sep 1984. Contract AC03-76SF00098. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004661.

This document discusses the requirements for a database management system that would satisfy the scientific needs of the Scientific Database Project. We give the major requirements of scientific data management, based on a system developed by Deutsch. Actual requirements, for each category, are identified as mandatory, important, and optional. Mandatory - we should not consider a DBMS unless it satisfies all mandatory requirements. Important -

these requirements, while not as crucial as the mandatory ones, are important to the easy and convenient implementation and operation of a scientific database. Optional - such features are nice extras. We expect that the scientific database project can be implemented and operated in any DBMS that meets all of the mandatory and most of the important requirements.

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The subject index is based on the use of subject descriptors selected from a controlled thesaurus of terms (DOE/TIC-7000). Subject descriptors and qualifiers (subheadings) are selected and presented in the following format:

SUBJECT DESCRIPTOR
Qualifier
Title, (supplementary information), citation number, (R;US)

The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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	10:10212	RFP—3644
	10:10309	RFP—3723
	10:10415	RFP—3602
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AC04-76DR00789	**Compania Sevillana de Electricidad, S.A., Madrid (Spain)**	
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AC04-76EV01013	**Inhalation Toxicology Research Inst., Albuquerque, NM**	
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AC05-76ER04014	**Florida Univ., Gainesville (USA). Dept. of Nuclear Engineering Sciences**	
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AC05-76OR00033	**Oak Ridge Associated Universities, Inc., TN (USA)**	
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AC05-79ER10084	**Mortada International, Dallas, TX (USA)**	
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AC05-84OR21400	**Oak Ridge National Lab., TN (USA)**	
	10:9430	ORNL—6108
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	Tennessee Univ., Knoxville (USA). Energy, Environment and Resources Center	
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AC05-84OR21486	**Air Products and Chemicals, Inc., Allentown, PA (USA)**	
	10:9459	DOE/OR/21486—T1
AC05-84OT21400	**Oak Ridge Gaseous Diffusion Plant, TN (USA)**	
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AC06-76FF02170	**Hanford Engineering Development Lab., Richland, WA (USA)**	
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AC06-76RL01830	**Pacific Northwest Lab., Richland, WA (USA)**	
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	10:9611	PNL-SA—12322
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	10:9629	PNL-SA—12173
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	10:10308	PNL-SA—12611
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AC06-77RL01030	**Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations**	
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AC06-81ER40048	**Department of Physics, University of Washington, Seattle, Washington 98195**	
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AC07-76ID01570	**Idaho National Engineering Lab., Idaho Falls (USA)**	
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	EG and G Idaho, Inc., Idaho Falls (USA)	
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	Utah Univ., Salt Lake City (USA). Research Inst.	
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	EG and G Idaho, Inc., Idaho Falls (USA)	
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	10:9907	EGG-M—19184
	NUS Corp., Gaithersburg, MD (USA)	
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AC07-79ID01675	**Brookhaven National Lab., Upton, NY (USA)**	
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AC07-84ID12435	**Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)**	
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AC09-76SR00001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant**	
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AC12-76SN00052	**Knolls Atomic Power Lab., Schenectady, NY (USA)**	
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AC18-80FC10225	**Southern Research Inst., Birmingham, AL (USA)**	
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AC18-84FC10614	**Brigham Young Univ., Provo, UT (USA). Combustion Lab.**	
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AC19-79BC10069	**Illinois Inst. of Tech., Chicago (USA). Dept. of Chemical Engineering**	
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AC20-82LC10843	**Ultrasystems, Inc., Irvine, CA (USA)**	
	10:9588	DOE/LC/10843—1690
AC21-79ET15465	**Southwest Research Inst., San Antonio, TX (USA)**	
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AC21-80ET15492	**Air Pollution Technology, Inc., San Diego, CA (USA)**	
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AC21-80MC14600	**Ingersoll-Rand Research, Inc., Princeton, NJ (USA)**	
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AC21-82FE05081	**Foster Wheeler Synfuels Corp., Livingston, NJ (USA)**	
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AC21-82MC19163	**Scientific Design Co., Inc., New York (USA)**	
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AC22-76ET10518	**State Univ. of New York, Buffalo (USA)**	
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	10:9436	DOE/ET/10518—T8
AC22-76ET10532	**Chevron Research Co., Richmond, CA (USA)**	
	10:9437	DOE/ET/10532—T19
AC22-80MC14617	**State Univ. of New York, Buffalo (USA). Dept. of Chemical Engineering**	
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AC22-80PC30072	**Rockwell International Science Center, Thousand Oaks, California 91360**	
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AC22-81PC40091	**American Cyanamid Co., Stamford, CT. Chemical Research Div.**	
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AC22-81PC40268	**Foster Wheeler Development Corp., Livingston, NJ (USA)**	
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AC22-81PC42302	**Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering**	
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AC22-82FE60148	**NOXSO Corp., Paducah, KY (USA)**	
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AC22-83PC60044	**Auburn Univ., AL (USA). Coal Conversion Lab.**	
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AC22-83PC60262	**Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.**	
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AC22-83PC60773	**United Coal Co., Bristol, VA (USA)**	
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AC22-83PC62690	**Bituminous Coal Research, Inc., Monroeville, PA (USA). National Lab.**	
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AC22-83PC62702	**OTISCA Industries Ltd., Syracuse, NY (USA)**	
	10:9537	DOE/PC/62702—T1
AC22-83PC63049	**Energy and Minerals Research Co., Exton, PA (USA)**	
	10:9538	DOE/PC/63049—T1
AI01-76ET10393	**NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)**	
	10:9543	DOE/ET/10393—1623
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AI01-76PR06010	**National Bureau of Standards, Washington, DC (USA). Center for Building Technology**	
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AI01-77CS51044	**Santa Clara Univ., CA (USA). Dept. of Mechanical Engineering**	
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AI01-78CS54209	**Kumm Industries, Inc., Tempe, AZ (US)**	
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AI01-81FE00016	**Foster-Miller Associates, Inc., Waltham, MA (USA)**	
	10:9513	DOE/FE/00016—T65
AI05-78OR06113	**National Bureau of Standards, Washington, DC (USA). Center for Fire Research**	
	10:10011	NBSIR—84-2917
AI08-80CS50208	**Air Force Logistics Command, Wright-Patterson AFB, OH (USA)**	
	10:10052	DOE/CS/50208—1
AI97-79ET44611	**Geological Survey, Lakewood, CO (USA)**	
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AS05-76ER05126	**National Science Foundation, Washington, DC (USA). Div. of Physics**	
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AS05-81ER40003	**Istituto di Scienze Fisiche, Universita degli Studi di Milano, 1-20133 Milano, Italy**	
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AS09-76EV00936	**Skidaway Inst. of Oceanography, Savannah, GA (USA)**	
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AS09-76SR00952	**Arizona Univ., Tucson (USA)**	
	10:9849	DOE/SR/00952—T11
AS09-77ER01023	**Department of Physics, University of Georgia, Athens, Georgia 30602**	
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AS09-80EV10331	**Skidaway Inst. of Oceanography, Savannah, GA (USA)**	
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AS09-81SR10714	**South Carolina Univ., Columbia (USA). Dept. of Chemical Engineering**	
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AS19-80BC10354	**Kansas Univ., Lawrence (USA)**	
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AT03-76ET51011	**GA Technologies, Inc., San Diego, CA (USA**	
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FC02-80CS30345	**C.E. Associates, Corvallis, OR (USA)**	
	10:10004	DOE/CS/30345—1
FC03-80SF11428	**Geothermal Food Processors, Inc., Fernley, NV (USA)**	
	10:9766	DOE/SF/11428—T1
FC05-77ET10069	**Exxon Research and Engineering Co., Florham Park, NJ (USA)**	
	10:9433	DOE/ET/10069—T99
FG01-80CS30555	**League for Innovation in the Community Coll., Dallas, TX (USA)**	
	10:9736	DOE/CS/30555—T1
FG01-81CS15071	**Solex Corp., Lowell, MA (USA)**	
	10:9752	DOE/CS/15071—T1
FG01-84CE64780	**Unified Industries, Inc., Springfield, VA (USA)**	
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FG02-80CS69105	**Minnesota Dept. of Energy and Economic Development, St. Paul (USA). Energy Div.**	
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FG02-81R510300	**Indiana Univ. East, Richmond (USA)**	
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FG02-84ER13197	**New York State Dept. of Health, Albany (USA). Center for Labs. and Research**	
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FG02-84ER13299	**Colorado State Univ., Fort Collins (USA). Dept. of Chemistry**	
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FG02-84ER45051	**Rochester Univ., NY (USA). Dept. of Mechanical Engineering**	
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FG02-84ER45077	**Pennsylvania State Univ., University Park (USA). Materials Research Lab.**	
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FG02-84ER52111	**Illinois Univ., Urbana (USA). Dept. of Electrical and Computer Engineering**	
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FG02-84ER53175	**Missouri Univ., Rolla (USA). Dept. of Physics**	
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FG03-79SF10565	**San Diego, County of, CA (USA)**	
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FG05-83ER75100	**Tennessee Univ., Knoxville (USA)**	
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FG05-84ER13213	**Howard Univ., Washington, DC (USA). Dept. of Chemistry**	
	10:10175	DOE/ER/13213—T1
FG06-79R000037	**Northwest Arctic School District, Kotzebue, AK (USA)**	
	10:9771	DOE/R0/00037—T1
FG06-81R001363	**Duszynski and Associates, Inc., Fairbanks, AK (USA)**	
	10:10007	DOE/R0/01363—T1
FG09-84ER40160	**Georgia Univ., Athens (USA). Dept. of Physics**	
	10:10516	DOE/ER/40160—1
FG18-81FE05111	**Massachusetts Executive Office of Energy Resources, Boston (USA)**	
	10:9511	DOE/FE/05111—1681
FG22-81PC40790	**Utah Univ., Salt Lake City (USA). Dept. of Fuels Engineering**	
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FG22-81PC40807	**Southern Illinois Univ., Carbondale (USA). Dept. of Engineering Mechanics and Materials**	
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FG22-83PC60779	**Signal UOP, Inc., Des Plaines, IL (USA). Research Center**	
	10:10159	DOE/PC/60779—5
FG22-83PC60783	**Air Products and Chemicals, Inc., Allentown, PA (USA)**	
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FG22-83PC60802	**Arizona Univ., Tucson (USA). Dept. of Chemical Engineering**	
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FG22-83PC60812	**Utah Univ., Salt Lake City (USA). Dept. of Fuels Engineering**	
	10:10170	DOE/PC/60812—T2
FG22-84PC70781	**Illinois Univ., Chicago (USA). Dept. of Chemical Engineering**	
	10:9483	DOE/PC/70781—T1
FG44-80R410333	**Alabama Univ., University (USA). School of Mines and Energy Development**	
	10:9512	DOE/R4/10333—T3
W-31-109-ENG-38	**Argonne National Lab., IL (USA)**	
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	Nucl. Technol./Fusion, 4: No. 2, 1095-1100(Sep 1983)			10:10721
	Nucl. Technol./Fusion, 4: No. 2, 1089-1094(Sep 1983)			10:10722
	Nucl. Technol./Fusion, 4: No. 2, 1079-1083(Sep 1983)			10:10723
	Nucl. Technol./Fusion, 4: No. 2, 1073-1079(Sep 1983)			10:10724
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	Nucl. Technol./Fusion, 4: No. 2, 395-400(Sep 1983)			10:10731
	Nucl. Technol./Fusion, 4: No. 2, 389-394(Sep 1983)			10:10732
	Nucl. Technol./Fusion, 4: No. 2, 433-438(Sep 1983)			10:10733
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	Nucl. Technol./Fusion, 4: No. 2, 1141-1145(Sep 1983)			10:10748
	Nucl. Technol./Fusion, 4: No. 2, 1308-1313(Sep 1983)			10:10749
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	Nucl. Technol./Fusion, 4: No. 2, 1392-1397(Sep 1983)			10:10755
	Nucl. Technol./Fusion, 4: No. 2, 1436-1444(Sep 1983)			10:10756
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	Nucl. Technol./Fusion, 4: No. 2, 1407-1412(Sep 1983)			10:10771
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	Nucl. Technol./Fusion, 4: No. 2, 647-653(Sep 1983)			10:10773
	Nucl. Technol./Fusion, 4: No. 2, 642-646(Sep 1983)			10:10774
	Nucl. Technol./Fusion, 4: No. 2, 555-560(Sep 1983)			10:10775
	Nucl. Technol./Fusion, 4: No. 2, 273-278(Sep 1983)			10:10776
	Nucl. Technol./Fusion, 4: No. 2, 539-543(Sep 1983)			10:10777
	Nucl. Technol./Fusion, 4: No. 2, 75-82(Sep 1983)			10:10778
	Nucl. Technol./Fusion, 4: No. 2, 348-352(Sep 1983)			10:10779
	Nucl. Technol./Fusion, 4: No. 2, 1135-1140(Sep 1983)			10:10780
	Nucl. Technol./Fusion, 4: No. 2, 1127-1130(Sep 1983)			10:10781
	Nucl. Technol./Fusion, 4: No. 2, 1479-1485(Sep 1983)			10:10782
	Nucl. Technol./Fusion, 4: No. 2, 407-411(Sep 1983)			10:10783
	Nucl. Technol./Fusion, 4: No. 2, 527-532(Sep 1983)			10:10784
	Nucl. Technol./Fusion, 4: No. 2, 361-366(Sep 1983)			10:10785
	Nucl. Technol./Fusion, 4: No. 2, 1497-1502(Sep 1983)			10:10786
	Nucl. Technol./Fusion, 4: No. 2, 112-115(Sep 1983)			10:10787
	Nucl. Technol./Fusion, 4: No. 2, 116-120(Sep 1983)			10:10788
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	Nucl. Technol./Fusion, 4: No. 2, 544-549(Sep 1983)			10:10790
	Nucl. Technol./Fusion, 4: No. 2, 550-554(Sep 1983)			10:10791
	Nucl. Technol./Fusion, 4: No. 2, 973-978(Sep 1983)			10:10792
	Nucl. Technol./Fusion, 4: No. 2, 1084-1088(Sep 1983)			10:10793
	Nucl. Technol./Fusion, 4: No. 2, 1245-1250(Sep 1983)			10:10794
	Nucl. Technol./Fusion, 4: No. 2, 3-5(Sep 1983)			10:10795
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	Nucl. Technol./Fusion, 4: No. 2, 218-223(Sep 1983)			10:10802
	Nucl. Technol./Fusion, 4: No. 2, 99-105(Sep 1982)			10:10813
CONF-830609-	(ANS annual meeting, Detroit, MI, USA, 12-17 Jun 1983)			
72	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005017	MN -25	10:9897
CONF-830795-	(Symposium on energy removal and particle control and toroidal fusion devices, Princeton, NJ, USA, 26-29 Jul 1983)			
	J. Nucl. Mater., 121: 61-68(May 1984)			10:10633
	J. Nucl. Mater., 121: 69-74(May 1984)			10:10634
	J. Nucl. Mater., 121: 115-125(May 1984)			10:10635
	J. Nucl. Mater., 121: 415-421(May 1984)			10:10636
	J. Nucl. Mater., 121: 41-47(May 1984)			10:10637
	J. Nucl. Mater., 121: 10-16(May 1984)			10:10638
	J. Nucl. Mater., 121: 29-35(May 1984)			10:10639
	J. Nucl. Mater., 121: 82-91(May 1984)			10:10640
	J. Nucl. Mater., 121: 92-99(May 1984)			10:10641
	J. Nucl. Mater., 121: 132-137(May 1984)			10:10642
	J. Nucl. Mater., 121: 157-163(May 1984)			10:10643
	J. Nucl. Mater., 121: 205-209(May 1984)			10:10644
	J. Nucl. Mater., 121: 144-150(May 1984)			10:10660
	J. Nucl. Mater., 121: 171-177(May 1984)			10:10661
	J. Nucl. Mater., 121: 178-183(May 1984)			10:10662
	J. Nucl. Mater., 121: 184-188(May 1984)			10:10663
	J. Nucl. Mater., 121: 189-193(May 1984)			10:10664
	J. Nucl. Mater., 121: 237-242(May 1984)			10:10665
	J. Nucl. Mater., 121: 243-248(May 1984)			10:10666
	J. Nucl. Mater., 121: 249-253(May 1984)			10:10667
	J. Nucl. Mater., 121: 264-270(May 1984)			10:10668
	J. Nucl. Mater., 121: 271-276(May 1984)			10:10669
	J. Nucl. Mater., 121: 277-282(May 1984)			10:10670
	J. Nucl. Mater., 121: 285-293(May 1984)			10:10671
	J. Nucl. Mater., 121: 294-303(May 1984)			10:10672
	J. Nucl. Mater., 121: 304-308(May 1984)			10:10673
	J. Nucl. Mater., 121: 309-315(May 1984)			10:10674
	J. Nucl. Mater., 121: 316-321(May 1984)			10:10675
	J. Nucl. Mater., 121: 322-328(May 1984)			10:10676
	J. Nucl. Mater., 121: 329-336(May 1984)			10:10677
	J. Nucl. Mater., 121: 337-343(May 1984)			10:10678
	J. Nucl. Mater., 121: 344-349(May 1984)			10:10679
	J. Nucl. Mater., 121: 350-360(May 1984)			10:10680
	J. Nucl. Mater., 121: 363-367(May 1984)			10:10681

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	J. Nucl. Mater., 121: 392-397(May 1984)			10:10682
	J. Nucl. Mater., 121: 398-403(May 1984)			10:10683
	J. Nucl. Mater., 121: 435-440(May 1984)			10:10684
	J. Nucl. Mater., 121: 441-448(May 1984)			10:10685
	J. Nucl. Mater., 121: 449-452(May 1984)			10:10686
CONF-8307126-	(3. annual summer school on high energy accelerators, Upton, NY, USA, 6-16 Jul 1983)			
2	*See* LBL-18403	DE85004662	MN -28	10:10250
CONF-830807-	(International conference on coal science, Pittsburgh, PA, USA, 15-19 Aug 1983)			
	See ECN-83-022			10:9549
CONF-8309103-	(9. international vacuum congress and 5. international conference on solid surfaces, Madrid, Spain, 26 Sep-1 Oct 1983)			
13	*See* PPPL-2163	DE85003885	STD -20f	10:10631
CONF-8309163-	(Conference on low energy tests of conservation laws in particle physics, Blacksburg, VA, USA, 12-14 Sep 1983)			
	American Institute of Physics, 335 E. 45th Street, New York, NY 10017	TI84012407	ND -34D	10:10522
CONF-8309205-	(Workshop on collective states in nuclei, Taiwan, China, 8-18 Sep 1983)			
	Nucl. Phys. A, 421: 27-42(11 Jun 1984)			10:10587
	Nucl. Phys. A, 421: 339-352(11 Jun 1984)			10:10588
CONF-831049-	(International seminar on indoor exposure to natural radiation and related risk assessment, Capri, Italy, 3-5 Oct 1983)			
	Radiat. Prot. Dosim., 7: No. 1-4, 23-39(1984)			10:10381
	Radiat. Prot. Dosim., 7: No. 1-4, 143-146(1984)			10:10382
	Radiat. Prot. Dosim., 7: No. 1-4, 381-384(1984)			10:10416
CONF-831187-	(29. annual conference on magnetics and magnetic materials, Pittsburgh, PA, USA, 8-11 Nov 1983)			
20	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005033	MN -25	10:10132
CONF-8311213-	(ASCOT data analysis workshop, Livermore, CA, USA, 7-11 Nov 1983)			
Summ.	*See* ASCOT-84-7	DE85004407	MN -11	10:10363
CONF-8311224-	(EPRI workshop on fuels-and combustion-related problems of oil-and gas-fired utility boilers, Atlanta, GA, USA, 30 Nov-1 Dec 1983)			
	See EPRI-AP-3753	TI85920085	ND -92	10:10233
CONF-831295-	(6. industrial hygiene convention, Rome, Italy, 5-7 Dec 1983)			
1	*See* SVC-83-37	TI85750115	ND -41	10:10423
CONF-840113-	(Symposium on space nuclear power systems, Albuquerque, NM, USA, 10-13 Jan 1984)			
10	*See* LA-UR-84-2651	DE84016460	MN -80	10:9844
CONF-840139-	(SPIE technical symposium and instrument exhibit, Los Angeles, CA, USA, 22-27 Jan 1984)			
7	*See* LBL-18412	DE85004894	MN -25	10:10138
CONF-840183-	(2. protostars and planets conference, Tucson, AZ, USA, 4-7 Jan 1984)			
1	*See* UCRL-90511	DE85003623	MN -34B	10:10487
CONF-8402101-	(Simposio Latino-Am. de Fis. dos sistemas amorfos, Niteroi, Brazil, 1 Feb 1984)			
1	*See* N-84-26408			10:10596
2	*See* N-84-26418			10:10597
CONF-8403127-	(5. Nordic meeting on nuclear physics, Jyvaskyla, Finland, 12-16 Mar 1984)			
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004068	MN -34C	10:10558
CONF-840422-	(International symposium on risks and benefits of energy systems, Juelich, F.R. Germany, 9-13 Apr 1984)			
2	*See* BNL-35459	DE85004540	MN -41	10:9957
CONF-8404201-	(23. annual Kentucky industrial coal conference, Lexington, KY, USA, 11-12 Apr 1984)			
11	University of Kentucky, 112 Frazer Hall, Lexington, KY	TI85900887	MN -90e	10:9542
CONF-8404216-	(Geoscience instrumentation workshop, Argonne, IL, USA, 19-20 Apr 1984)			
	See ANL/EES-TM-266	DE85004359	MN -37	10:10314
CONF-8405193-	(Conference on the intersections between particle and nuclear physics, Steamboat Springs, CO, USA, 23-30 May 1984)			
	American Institute of Physics, 335 E. 45th Street, New York, NY 10017	TI85004178	ND -34D	10:10507
CONF-8405235-	(International congress on the prospects and problems of coal-fired power plants, Brindisi, Italy, 10-13 May 1984)			
2	*See* BNL-35460	DE85004043	MN -41	10:9504
CONF-8405260-	(Molecular dynamics workshop, Chapel Hill, NC, USA, 14-18 May 1984)			
1	*See* BNL-35475	DE85003610	MN -48	10:10399

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CONF-8405261-	(Annual conference of the Institute of Industrial Engineers, Chicago, IL, USA, 6-10 May 1984)			
1	Public Relations, Institute of Industrial Engineers, 25 Technology, Atlanta-Norcross, GA 30092	TI85900229	MN -95	10:10040
CONF-8405262-	(Southwest regional conference for astronomy and astrophysics, Los Alamos, NM, USA, 1 May 1984)			
1	*See* LA-UR-84-3688	DE85003736	MN -34B	10:10455
CONF-8406139-	(9. international CODATA conference, Jerusalem, Israel, 24-28 Jun 1984)			
8	*See* RFP-3714	DE85005185	MN -4	10:10168
CONF-8406186-	(59. Nobel symposium - the physics of chaos and related phenomena, Graeftavallen, Sweden, 11-16 Jun 1984)			
2	*See* LBL-17914	DE85004909	MN -34	10:10593
CONF-8406187-	(6. symposium on applied surface analysis, Dayton, OH, USA, 6-8 Jun 1984)			
2	*See* BNL-35534	DE85004541	MN -34A	10:10122
CONF-8406198-	(Design and utilization of the superconducting super collider summer study, Snowmass, CO, USA, 23 Jun-13 Jul 1984)			
28	*See* BNL-35492	DE85004645	MN -28	10:10292
29	*See* LBL-18479	DE85004897	MN -34D	10:10513
30	*See* LA-UR-84-3627	DE85003739	MN -34	10:10277
CONF-840738-	(Progress in quantitative NDE, San Diego, CA, USA, 8-13 Jul 1984)			
11	*See* PNL-SA-12237	DE85003110	MN -78	10:9932
CONF-840767-	(Microbeam Analysis Society analytical electron microscopy meeting, Bethlehem, PA, USA, 16-20 Jul 1984)			
11	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005379	MN -25	10:10060
CONF-840774-	(Workshop on radiation survey instruments and calibrations, Gaithersburg, MD, USA, 10-12 Jul 1984)			
2	*See* PNL-SA-12611	DE85003017	MN -37	10:10308
CONF-840783-	(9. international congress on photobiology, Philadelphia, PA, USA, 3 Jul 1984)			
4	*See* BNL-35577	DE85004711	MN -48	10:10400
CONF-840874-	(Symposium on neutron scattering, Berlin, F.R. Germany, 9 Aug 1984)			
	See HMI-B-411		ND -25	10:10589
CONF-840876-	(International conference on valence fluctuations, Koln, F.R. Germany, 27-30 Aug 1984)			
4	*See* IS-M-522	DE85003069	MN -34	10:10605
CONF-840879-	(17. international conference on the physics of semiconductors, San Francisco, CA, USA, 6-10 Aug 1984)			
11	*See* LBL-17904	DE85004903	MN -25	10:10137
CONF-840884-	(International conference on the structure and properties of internal interfaces, Irsee, F.R. Germany, 19-23 Aug 1984)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004024	MN -25	10:10061
CONF-8408110-	(2. workshop on high-energy ion-atom collision processes, Debrecen, Hungary, 27-28 Aug 1984)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004435	MN -34A	10:10494
CONF-8408130-	(13. international congress of the International Union of Crystallography, Hamburg, F.R. Germany, 9-18 Aug 1984)			
	Acta Crystallogr., Sect. A, 40: C-375/C-376(1 Aug 1984)			10:10119
CONF-8408132-	(Conference on solar neutrinos and neutrino astronomy, Lead, SD, USA, 23-25 Aug 1984)			
1	*See* BNL-35705	DE85004710	MN -34B	10:10452
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004031	MN -34B	10:10295
5	*See* LA-UR-84-3583	DE85003741	MN -34B	10:10454
CONF-8408133-	(Japan/US seminar on fundamentals of structural ceramics, Seattle, WA, USA, 1 Aug 1984)			
2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004019	MN -25	10:10226
CONF-8408134-	(Practical applications of ground water models symposium, Columbus, OH, USA, 15-17 Aug 1984)			
1	*See* PNL-SA-12173	DE85003645	MN -51	10:9629
CONF-8408136-	(International workshop on the electromagnetic response of surfaces, Cholula, Mexico, 6-10 Aug 1984)			
1-Draft	NTIS, PC A02/MF AO1; 1 (GPO Dep.)	DE85003541	MN -34	10:10063
CONF-8408137-	(Molecular crystals and liquid crystal meeting, Abano, Terme, Italy, 1 Aug 1984)			
1	*See* BNL-35425	DE85003624	MN -4	10:10128
CONF-840902-	(5. ASTM-Euratom symposium on reactor dosimetry, Geesthacht, F.R. Germany, 24-28 Sep 1984)			
17	*See* HEDL-SA-3125	DE85003018	MN -78	10:9868
CONF-840916-	(Robotics and remote handling in the nuclear industry conference, Toronto, Ontario, Canada, 23-27 Sep 1984)			
6	*See* TRI-PP-84-93	DE85900435	MN -48	10:10404

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CONF-840937-	(Applied superconductivity conference, San Diego, CA, USA, 9-13 Sep 1984)			
22	*See* LBL-17655	DE85005166	MN -28	10:10197
24	*See* LBL-17747	DE85005167	MN -25	10:10069
25	*See* SLAC-PUB-3433	DE85004381	MN -28	10:10251
26	*See* BNL-35375	DE85004699	MN -25	10:10604
CONF-8409104-	(59. annual Society of Petroleum Engineers of AIME technical conference, Houston, TX, USA, 16-19 Sep 1984)			
	Soc. Pet. Eng. AIME, Pap., SPE13257: 16(Sep 1984)			10:9562
	Soc. Pet. Eng. AIME, Pap., SPE13213: 12(Sep 1984)			10:9563
	Soc. Pet. Eng. AIME, Pap., SPE13215: 16(Sep 1984)			10:9564
	Soc. Pet. Eng. AIME, Pap., SPE13224: 12(Sep 1984)			10:9565
	Soc. Pet. Eng. AIME, Pap., SPE13226: 11(Sep 1984)			10:9566
	Soc. Pet. Eng. AIME, Pap., SPE13253: 14(Sep 1984)			10:9567
	Soc. Pet. Eng. AIME, Pap., SPE13072: 14(Sep 1984)			10:9568
CONF-8409109-	(Industrial temperature measurement symposium, Knoxville, TN, USA, 10-12 Sep 1984)			
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004434	MN -78	10:9862
CONF-8409162-	(6. international symposium on high energy spin physics, Marseille, France, 12-19 Sep 1984)			
8	*See* BNL-35488	DE85004190	MN -34D	10:10508
CONF-8409184-	(13. international conference on the Unity of the Sciences, Washington, DC, USA, 2-5 Sep 1984)			
1	*See* UCRL-91451	DE85004422	MN -11	10:10362
CONF-8409186-	(Magnetic refrigeration workshop, Los Alamos, NM, USA, 20-21 Sep 1984)			
1	*See* EGG-M-21984	DE85003405	MN -95d	10:10008
CONF-8409187-	(8. international workshop on condensed matter theories, Granada, Spain, 17-28 Sep 1984)			
1	*See* LA-UR-84-3470	DE85003746	MN -34C	10:10585
CONF-8409189-	(Nuclear records management symposium, Nashville, TN, USA, 10-12 Sep 1984)			
1	*See* EGG-M-08384	DE85003402	MN -2	10:10814
CONF-8409191-	(Cell transformation assays conference, Research Triangle Park, NC, USA, 11-15 Sep 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85002746	MN -48	10:10410
CONF-8409192-	(4. international seminar on TL and ESR dating, Worms, F.R. Germany, 1 Sep 1984)			
1	*See* BNL-35487	DE85004382	MN -25	10:10291
CONF-8409193-	(2. international conference on hydrocyclones, Bath, UK, 19 Sep 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005066	MN -90b	10:9529
CONF-841005-	(Instrumentation for heavy ion nuclear research conference, Oak Ridge, TN, USA, 22-26 Oct 1984)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004029	MN -37	10:10294
CONF-841007-	(Nuclear science symposium, Orlando, FL, USA, 31 Oct-2 Nov 1984)			
36	*See* ANL/HEP-CP-84-85	DE85004016	MN -28	10:10258
37	*See* BNL-35595	DE85004701	MN -37	10:10293
CONF-841010-	(Meeting of the Plasma Physics Division of the American Physical Society, Boston, MA, USA, 27 Oct-3 Nov 1984)			
11	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003335	MN -20	10:10619
12	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85003333	MN -20	10:10620
13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003682	MN -20	10:10621
CONF-841017-	(Specialists' meeting on reactor noise - SMORN IV, Dijon, France, 15-19 Oct 1984)			
9	NTIS, PC A02; 3	DE85002475	MN -78	10:9898
CONF-841075-	(International thermal hydraulics and plant operations topical meeting, Taipei, Taiwan, 22-24 Oct 1984)			
7	*See* BNL-NUREG-35288	TI85003516	MN -78	10:9894
CONF-841077-	(Statistics symposium on national energy issues, Seattle, WA, USA, 16-18 Oct 1984)			
3	*See* PNL-SA-12616	DE85004554	MN -15	10:9634
CONF-8410142-	(12. water reactor safety research information meeting, Gaithersburg, MD, USA, 23-26 Oct 1984)			
31	*See* SAND-84-1655C	DE85002623	MN -78	10:9935
35	*See* SAND-84-1759C	DE85002642	MN -78	10:10124
39	*See* UCRL-91731	DE85003145	MN -78	10:9940
41	*See* EGG-M-18784	DE85003411	MN -78	10:9906
51	*See* EGG-M-19184	DE85003420	MN -78	10:9907
56	*See* EGG-M-18284	DE85003409	MN -78	10:9803
64	*See* PNL-SA-12667	DE85003599	MN -78	10:9933
66	*See* BNL-NUREG-35441	TI85004157	MN -80	10:9895
CONF-8410153-	(7. heat pump technology conference, Tulsa, OK, USA, 15-16 Oct 1984)			
5	NTIS, PC A02; 3	DE85002470	MN -95d	10:10002
CONF-8410165-	(DOE model validation workshop, Charleston, SC, USA, 23-26 Oct 1984)			
5	*See* UCRL-91856	DE85004992	MN -90i	10:10377

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CONF-8410173-	(International meeting on reduced enrichment for research and test reactors, Argonne, IL, USA, 14-18 Oct 1984)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004075	MN -25	10:10134
4	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004037	MN -83	10:9590
CONF-8410198-	(12. DOE compatibility meeting, Kansas City, KS, USA, 16-18 Oct 1984)			
1	*See* UCRL-91581	DE85003148	MN -25	10:10082
CONF-8410199-	(IAEA IWGFR specialists meeting on predictions and experience of core, South Manchester, UK, 22 Sep 2517,-4 Oct 1984)			
1	*See* HEDL-SA-3213-FP	DE85002999	MN -79e	10:9821
2	*See* HEDL-SA-3211-FP	DE85003008	MN -79e	10:9820
CONF-8410200-	(Materials Research Society symposium, Cambridge, MA, USA, 1 Oct 1984)			
1	*See* IS-M-524	DE85003079	MN -34C	10:10106
CONF-8410201-	(NASA workshop on tunable solid state lasers for remote sensing, Stanford, CA, USA, 1-3 Oct 1984)			
1	*See* UCRL-91670	DE85003142	MN -21	10:10213
CONF-8410202-	(IUCF workshop on nuclear physics with stored cooled beams, Spencer, IN, USA, 14-17 Oct 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004072	MN -34A	10:10269
CONF-8410203-	(9. All-Union conference on charged particle accelerators, Dubna, USSR, 16-18 Oct 1984)			
1	*See* TRI-PP-84-96	DE85900433	MN -28	10:10278
CONF-841105-	(Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, Washington, DC, USA, 11-16 Nov 1984)			
37	*See* HEDL-SA-3178-FP	DE85002996	MN -79e	10:9915
49	*See* EGG-M-14784	DE85004318	MN -78	10:9905
CONF-841117-	(8. conference on the application of accelerators in research and industry, Denton, TX, USA, 12-14 Nov 1984)			
8-Rev.1	*See* UCRL-91043-Rev.1	DE85004991	MN -28	10:10591
28	*See* BNL-35594	DE85005132	MN -28	10:10492
31	*See* BNL-35310	DE85004055	MN -28	10:10267
32	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004443	MN -34A	10:10493
CONF-841136-	(6. annual North American meeting of the International Association of Energy Economists, San Francisco, CA, USA, 5-7 Nov 1984)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004036	MN -11	10:9958
CONF-841156-	(Nuclear science symposium, Orlando, FL, USA, 1 Nov 1984)			
2	*See* PNL-SA-12263	DE85004549	MN -37	10:10307
CONF-841157-	(Symposium on the scientific basis for nuclear waste management, Boston, MA, USA, 26-29 Nov 1984)			
28	*See* EGG-M-14284	DE85004005	MN -25	10:10065
29	*See* PNL-SA-12746	DE85004551	MN -70	10:9613
30	*See* PNL-SA-12325	DE85004529	MN -70	10:9612
31	*See* PNL-SA-12344	DE85004548	MN -70	10:10079
32	*See* PNL-SA-12321	DE85004578	MN -70	10:9610
33	*See* PNL-SA-12322	DE85004544	MN -70	10:9611
34	*See* LBL-18549	DE85005165	MN -25	10:10163
35	*See* BNL-35559	DE85004058	MN -25	10:101?'
36	*See* SAND-84-1254C	DE85003988	MN -25	10:1014,
37	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004033	MN -25	10:10062
38	*See* SAND-84-0478C	DE85004466	MN -25	10:10144
39	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004064	MN -70	10:9603
45	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005091	MN -25	10:10133
CONF-841184-	(30. annual conference on magnetism and magnetic materials, San Diego, CA, USA, 27-30 Nov 1984)			
21	*See* BNL-35480	DE85004164	MN -25	10:10129
22	*See* BNL-35482	DE85004207	MN -25	10:10059
27	*See* BNL-35481	DE85004188	MN -25	10:10058
28	*See* SAND-84-1464C	DE85000470	MN -25	10:10599
29	*See* BNL-35505	DE85004697	MN -25	10:10130
CONF-841187-	(5. DOE environmental protection information meeting, Albuquerque, NM, USA, 6-8 Nov 1984)			
18	*See* EGG-M-24884	DE85004316	MN -70B	10:9627
19	*See* EGG-M-24284	DE85004315	MN -70B	10:9626
21	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004080	MN -41	10:9630
22	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004079	MN -11	10:9631
23	*See* BNL-35660-R	DE85005125	MN -41	10:10389
CONF-8411101-	(3. annual western gas sands sub-program review, Morgantown, WV, USA, 7-8 Nov 1984)			
1	*See* UCRL-89890-84	DE85004997	MN -91	10:9581
CONF-8411108-	(Arctic energy technologies workshop, Morgantown, WV, USA, 14-15 Nov 1984)			
1	*See* SAND-84-2192C	DE85004908	MN -11	10:10441
CONF-8411109-	(Workshop on inelastic deformation and failure modes, Evanston, IL, USA, 18-21 Nov 1984)			
2	*See* SAND-84-2384C	DE85004292	MN -38	10:10192

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CONF-8411111-	(Japan/US joint symposium on compact toroid research, Hiroshima, Japan, 13-15 Nov 1984)			
3	*See* LA-UR-84-3576	DE85003742	MN -20g	10:10655
CONF-8411114-	(Association of System 2000 Users for Technology Exchange conference (ASTUTE), Hilton Head, SC, USA, 11-15 Nov 1984)			
2	*See* LA-UR-84-3537	DE85003748	MN -32	10:10815
CONF-8411118-	(Meeting on nuclear standard reference data, Geel, Belgium, 12-16 Nov 1984)			
1	*See* LA-UR-84-3557	DE85003728	MN -34C	10:10580
4	*See* BNL-NCS-35514	DE85004703	MN -2	10:10561
6	*See* BNL-NCS-35521	DE85004911	MN -34C	10:10579
7	*See* BNL-NCS-35513	DE85005130	MN -34C	10:10578
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005014	MN -34C	10:10533
CONF-8411119-	(IEEE ultrasonics symposium, Dallas, TX, USA, 14-16 Nov 1984)			
3	*See* SAND-84-1373C	DE85003250	MN -34	10:10598
4	*See* KAPL-4181	DE85003663	STD -37	10:10317
CONF-8411122-	(American Civil Defense Association annual meeting, Daytona Beach, FL, USA, 15-16 Nov 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003505	MN -41	10:10356
CONF-8411123-	(11. annual aquatic toxicity workshop, Vancouver, Canada, 13-15 Nov 1984)			
1	*See* PNL-SA-12427	DE85003637	MN -90a	10:10421
CONF-8411126-	(Code developers conference, San Diego, CA, USA, 6-8 Nov 1984)			
1	*See* UCRL-91734	DE85003144	MN -32	10:10818
CONF-8411128-	(International conference on dynamic fracture mechanics, San Antonio, TX, USA, 7-9 Nov 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003063	MN -78	10:9904
CONF-8411130-	(Eastern oil shale symposium, Lexington, KY, USA, 27-28 Nov 1984)			
1	*See* LA-UR-84-3673	DE85003738	MN -91	10:9584
CONF-841203-	(6. international conference on fracture, New Delhi, India, 4-10 Dec 1984)			
3	*See* UCRL-91763	DE85003226	MN -38	10:10228
CONF-841210-	(International chemical congress of Pacific Basin Societies, Honolulu, HI, USA, 16-21 Dec 1984)			
5	*See* IS-M-506	DE85003216	MN -4	10:10152
6	*See* LA-UR-84-3755	DE85003735	MN -25	10:10179
8	*See* SAND-84-2574C	DE85003949	MN -4	10:10146
CONF-841218-	(31. national vacuum symposium, Reno, NV, USA, 3-7 Dec 1984)			
16	*See* UCRL-91802	DE85004998	MN -20	10:10632
CONF-841229-	(International symposium on americium and curium science and technology, Honolulu, HI, USA, 16-22 Dec 1984)			
1	*See* RFP-3705	DE85004972	MN -10	10:10167
CONF-841231-	(DOE/ORNL heat pump conference, Washington, DC, USA, 10-13 Dec 1984)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004433	MN -95d	10:10001
CONF-841237-	(1. annual acid deposition emissions inventory symposium, Raleigh, NC, USA, 3-4 Dec 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004085	MN -11	10:10365
CONF-841246-	(1. international conference on fusion reactor materials, Tokyo, Japan, 3-6 Dec 1984)			
7	*See* EGG-M-26084	DE85003945	MN -20c	10:10654
CONF-850101-	(International congress on hydrology of rocks of low permeability, Tucson, AZ, USA, 7-12 Jan 1985)			
2	*See* LBL-17449	DE85004654	MN -70	10:10434
3	*See* LBL-17490	DE85004660	MN -70	10:10435
CONF-850106-	(18. midyear topical symposium of the Health Physics Society, Colorado Springs, CO, USA, 6-10 Jan 1985)			
3	*See* DP-MS-84-76	DE85003445	MN -41	10:10390
CONF-850136-	(23. AIAA aerospace sciences meeting, Reno, NV, USA, 14-17 Jan 1985)			
2	*See* LA-UR-84-3577	DE85003733	MN -37	10:10305
CONF-850206-	(International ANS/ENS topical meeting on probabilistic safety methods and applications, San Francisco, CA, USA, 24-28 Feb 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84015818	MN -79	10:9899
2	*See* UCRL-91471	DE84017102	MN -15	10:9633
3-Summ.	*See* SAND-84-1887C	DE84017058	MN -80	10:9938
4	NTIS, PC A02/MF A01 (GPO Dep.)	DE85000078	MN -78	10:9900
5	NTIS, PC A02/MF A01 (GPO Dep.)	DE85002101	MN -80	10:9901
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000092	MN -79	10:9902
7	*See* BNL-NUREG-35236	TI85001230	MN -80	10:9893
8	NTIS, PC A02/MF A01 (GPO Dep.)	DE85002554	MN -80	10:9903
9	*See* SAND-84-1851C	DE85003694	MN -41	10:9937
10	*See* SAND-84-1824C	DE85003338	MN -80	10:9936
11	*See* SAND-84-1450C	DE85003119	MN -80	10:9934

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CONF-850211-	(Annual meeting of the Society of Mining Engineers, New York, NY, USA, 24-28 Feb 1985)			
1	*See* HEDL-SA-3196-FP	DE85001068	MN -25	10:10066
2	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004040	MN -90a	10:9482
CONF-850218-	(ASME wind energy symposium, Dallas, TX, USA, 17-20 Feb 1985)			
1	*See* SAND-84-1287C	DE85002631	MN -60	10:9775
2	*See* SAND-84-1227C	DE85003450	MN -60	10:9767
3	*See* SERI/TP-214-2563	DE85000530	MN -60	10:9776
CONF-850219-	(Offshore mechanics and arctic engineering symposium, Dallas, TX, USA, 17-21 Feb 1985)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85002766	MN -38	10:10214
CONF-850242-	(7. symposium on management of uranium mill tailings, low-level waste and hazardous waste, Ft. Collins, CO, USA, 6-8 Feb 1985)			
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004023	MN -70	10:9604
4	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004028	MN -70	10:9625
CONF-850311-	(National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, MA, USA, 25-29 Mar 1985)			
2	*See* BNL-NUREG-35629	TI85004208	MN -80	10:9861
COO-				
1195-491	*See* DOE/ER/01195-491	DE85000715	MN -34D	10:10509
2217-46	*See* DOE/EV/02217-46	DE85004290	MN -48	10:10430
CTA-IEAV-NT-				
012/ 83	NTIS (US Sales Only), PC A02/MF A01	DE84703428	MN -80	10:9852
DOE/BC/10069-				
27	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004001	MN -92a	10:9559
DOE/BC/10354-				
14	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003920	MN -92a	10:9560
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0118	NTIS, PC A03/MF A01 (GPO Dep.)	DE85005144	STD -95	10:10041
DOE/CE/64780-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004425	MN -95c	10:10003
DOE/CS/15071-				
T1	NTIS, PC A02; 3	DE85004288	MN -59a	10:9752
DOE/CS/30345-				
1	NTIS, PC A03/MF A01 (GPO Dep.)	DE85000430	MN -59b	10:10004
DOE/CS/30555-				
T1	NTIS, PC A05/MF A01 (GPO Dep.)	DE85005212	MN -58c	10:9736
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T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85000564	STD -93	10:9777
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1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003939	MN -96	10:10052
DOE/CS/54209-				
20	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85004579	STD -96	10:10054
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5	NTIS, PC A05/MF A01 (GPO Dep.)	DE85003993	MN -95d	10:10005
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T99	NTIS, PC A08/MF A01 (GPO Dep.)	DE85003890	MN -90d	10:9432
DOE/DR/00789-				
T100	NTIS MF A01; 2 (GPO Dep.)	DE85004420	MN -59a	10:9711
DOE/EIA-				
0035(84/ 08)	NTIS, PC A06/MF A01; 1 - GPO (GPO Dep.)	DE85004280	MN -98	10:9979
0035(84/ 09)	NTIS, PC A06/MF A01 - GPO (GPO Dep.)	DE85005102	MN -98	10:9980
0109(84/ 10)	NTIS, PC A05/MF A01; 1 - GPO (GPO Dep.)	DE85002878	MN -98B	10:9574
0458	NTIS, PC A05/MF A01; 1 - GPO (GPO Dep.)	DE85003876	MN -98G	10:10006
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0196	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004493	MN -11	10:9959
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491	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85000715	MN -34D	10:10509
DOE/ER/03285-				
47	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004286	MN -34D	10:10515
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14	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004464	MN -80	10:9874
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6	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85003927	MN -4	10:10064
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DOE/ER/05126-				
183	NTIS, PC A03/MF A01 (GPO Dep.)	DE85003016	MN -34D	10:10584
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T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85003979	MN -92a	10:9974
DOE/ER/10381-				
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004285	MN -4	10:10157
DOE/ER/10386-				
T2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85005204	MN -38	10:10243
DOE/ER/10569-				
T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004889	MN -34A	10:10256
DOE/ER/10667-				
T2	NTIS, PC A06/MF A01 (GPO Dep.)	DE85005202	MN -34D	10:10511

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DOE/ER/12089-1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85004091	MN -62	10:9737
DOE/ER/13197-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004304	MN -48	10:9651
DOE/ER/13213-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85005177	MN -4	10:10175
DOE/ER/13299-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004883	MN -4	10:10158
DOE/ER/40160-1	NTIS, PC A02; 3	DE85005004	MN -34D	10:10516
DOE/ER/45051-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003912	MN -25	10:10135
DOE/ER/45077-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004715	MN -25	10:10136
DOE/ER/52111-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004284	MN -20	10:10649
DOE/ER/53175-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004307	MN -20	10:10622
DOE/ER/60007-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003923	MN -90a	10:10150
DOE/ER/75100-T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85004092	MN -13	10:9953
DOE/ET/00913-3	NTIS, PC A03/MF A01 (GPO Dep.)	DE85004311	MN -4	10:10176
DOE/ET/10069-T99	NTIS (US Sales Only), PC A05/MF A01; 1 (GPO Dep.)	DE85003901	MN -90d	10:9433
DOE/ET/10393-1623	NTIS, PC A19/MF A01; 1 (GPO Dep.)	DE84012018	STD -90e	10:9543
1691	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE85001976	STD -90e	10:9544
DOE/ET/10518-T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004179	MN -90d	10:9434
T7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005115	MN -90d	10:9435
T8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004107	MN -90d	10:9436
DOE/ET/10532-T19	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84015496	STD -90d	10:9437
DOE/ET/15465-1298	NTIS, PC A05/MF A01; 1	DE83006413	STD -90e	10:9530
DOE/ET/15492-T61	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005217	MN -90i	10:9487
DOE/ET/34215-36	NTIS (US Sales Only), PC A03/MF A01; 1 (GPO Dep.)	DE85005097	STD -78	10:9867
DOE/ET/51013-97	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004846	MN -20f	10:10623
98	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004919	MN -20	10:10650
127	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004959	MN -20a	10:10651
129	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85004960	MN -20a	10:10652
130	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004961	MN -20	10:10653
DOE/EV/00936-1-Vol.1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004610	MN -48	10:10446
DOE/EV/02217-46	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004290	MN -48	10:10430
DOE/EV/10331-T4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004004	MN -11	10:10447
DOE/FC/10225-1650	NTIS, PC A05/MF A01 (GPO Dep.)	DE84017054	STD -90i	10:9488
DOE/FC/10489-1694	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004809	STD -90e	10:9545
DOE/FC/10614-T16	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005175	MN -90e	10:9546
DOE/FC/QTR-82/ 4-83/ 1	NTIS, PC A11/MF A01 (GPO Dep.)	DE85004811	STD -90	10:9531
DOE/FE-0037/ 3	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004913	MN -92	10:9578
DOE/FE/00016-T65	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005218	MN -88	10:9513
DOE/FE/05081-1710	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85005413	STD -90c	10:9438
DOE/FE/05111-1681	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE85004810	STD -90	10:9511
DOE/FE/60148-T7	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003784	MN -90a	10:9489
T8	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003783	MN -90a	10:9490
DOE/FE/60406-T1-Vol.1	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE85005079	MN -11	10:9963
T1-Vol.2	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE85005080	MN -11	10:9964
T1-Vol.3	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE85005081	MN -11	10:9965
T1-Vol.5	NTIS, PC A14/MF A01; 1 (GPO Dep.)	DE85005083	MN -11	10:9966
DOE/ID-10123	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85004905	STD -66a	10:9762
DOE/LC/10843-1690	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85001980	STD -91	10:9588

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DOE/MC/14600-1667	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85001485	STD -90b	10:9439
DOE/MC/14617-T2	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004224	MN -90d	10:9491
T3	NTIS, PC A03/MF A01 (GPO Dep.)	DE85004209	MN -90d	10:9492
T4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004225	MN -90d	10:9493
T5	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004213	MN -90d	10:9494
DOE/MC/19163-1712	NTIS, PC A15/MF A01 (GPO Dep.)	DE85005410	STD -90c	10:9440
DOE/NASA-0143-1	*See* DOE/NBB-0067	DE85005223	STD -96	10:10056
DOE/NBB-0067	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85005223	STD -96	10:10056
DOE/NBM-5002872	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE85002872	STD -79d	10:9819
DOE/OR/03054-T36	*See* DOE/OR/21486-T1	DE85004623	STD -89	10:9459
DOE/OR/21400-T78	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004427	MN -10	10:10177
DOE/OR/21486-T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85004623	STD -89	10:9459
DOE/PC/40091-T11	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004848	STD -90d	10:9460
DOE/PC/40268-T7	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004219	MN -90a	10:9547
DOE/PC/40790-T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85004298	MN -90a	10:9461
DOE/PC/42302-2-Vol.1	NTIS, PC A03/MF A01 (GPO Dep.)	DE85005085	MN -90a	10:9532
2-Vol.2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85005086	MN -90a	10:9533
T1	NTIS, PC A04/MF A01 (GPO Dep.)	DE85005087	MN -90a	10:9534
T2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85000503	MN -90a	10:9535
DOE/PC/60044-T4	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001703	STD -90a	10:9462
DOE/PC/60262-T10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004543	MN -90i	10:9496
DOE/PC/60773-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005057	MN -90d	10:9536
DOE/PC/60779-5	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004975	MN -90a	10:10159
DOE/PC/60783-3	NTIS, PC A04/MF A01 (GPO Dep.)	DE85004373	STD -90d	10:9463
DOE/PC/60802-1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003318	MN -90i	10:9548
DOE/PC/60812-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004238	MN -90d	10:10170
DOE/PC/62702-T1	NTIS, PC A05/MF A01 (GPO Dep.)	DE85005232	STD -90b	10:9537
DOE/PC/63049-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004150	MN -90a	10:9538
DOE/PC/70781-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003973	MN -90b	10:9483
DOE/R0/00037-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004503	MN -60	10:9771
DOE/R0/01363-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004502	MN -95d	10:10007
DOE/R4/10333-T3	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85004003	MN -90	10:9512
DOE/R5/10300-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003926	MN -59b	10:9738
DOE/SF/10565-T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85004484	MN -59b	10:9739
DOE/SF/11428-T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85004487	MN -66g	10:9766
DOE/SF/11556-T2	NTIS, PC A03/MF A01 (GPO Dep.)	DE85004483	MN -66d	10:9763
DOE/SF/12197-T3	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004692	MN -66	10:9764
DOE/SR/00952-T11	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85004186	MN -83	10:9849
DOE/SR/10714-1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85005007	MN -86	10:9605
DOE/TIC-3402	NTIS, PC A99/MF A01; 1 (GPO Dep.)	DE84012321	STD -90i	10:9497
DOE/TRU-8302	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004301	MN -70	10:9606
DP-MS-84-76	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003445	MN -41	10:10390
Ds-I-1983:4	NTIS (US Sales Only), MF A01; 2	DE85750162	MN -13	10:9971
DTH-LFK-F67-01	NTIS (US Sales Only), PC A04; 3	DE85750141	MN -38	10:10244
DTH-LV-MEDD-124	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750126	MN -59b	10:9740

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126	NTIS (US Sales Only), PC A04/MF A01	DE85750129	MN -59a	10:9754
132	NTIS (US Sales Only), PC A03/MF A01	DE85750139	MN -59a	10:9741
134	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750148	MN -94e	10:9946
138	NTIS (US Sales Only), PC A03/MF A01	DE85750130	MN -59a	10:9742
142	NTIS (US Sales Only), PC A06/MF A01; 1	DE85750135	MN -59b	10:9947
143	NTIS (US Sales Only), MF A01; 2	DE85750150	MN -59b	10:9712
145	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750132	MN -59b	10:9743
146	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750131	MN -59a	10:9744
147	NTIS (US Sales Only), PC A07/MF A01; 1	DE85750147	MN -59a	10:9755
148	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750153	MN -59a	10:9745
149	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750154	MN -94d	10:9756
E-				
1726	*See* N-84-21740			10:10115
1967	*See* N-84-30528			10:9951
1994	*See* N-84-26484			10:10051
2005	*See* N-84-29307			10:9655
2067	*See* N-84-21849			10:10222
2131	*See* N-84-29347			10:9773
ECN-				
83-022	Netherlands Energy Research Foundation, P.O. Box 1, NL-1755 ZG, Petten			10:9549
EEV-				
83-02	NTIS (US Sales Only), PC A08/MF A01; 1	DE85750123	MN -60	10:9772
EFN-TEKNIK-				
83/ 6	NTIS (US Sales Only), PC A06/MF A01; 1	DE85750180	MN -63	10:9701
EGG-				
2037	*See* NUREG/CR-0169-Vol.22	TI85005151	MN -78	10:9878
2246	*See* NUREG/CR-3195	TI83011206	MN -78	10:9923
2345	*See* NUREG/CR-3994	TI85001619	MN -70B	10:9632
2348	*See* NUREG/CR-4017	TI85005153	MN -80	10:9872
2351	*See* NUREG/CR-4032	TI85003960	MN -78	10:9810
EGG-IS-				
6494(6-84)	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004694	MN -32	10:10827
EGG/LTR-				
144-8-Suppl.2	NTIS, PC A03; 3	DE85004837	MN -78	10:9875
EGG-M-				
08384	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003402	MN -2	10:10814
14284	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004005	MN -25	10:10065
14784	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004318	MN -78	10:9905
18284	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85003409	MN -78	10:9803
18784	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003411	MN -78	10:9906
19184	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003420	MN -78	10:9907
21984	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003405	MN -95d	10:10008
24284	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004315	MN -70B	10:9626
24884	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004316	MN -70B	10:9627
26084	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003945	MN -20c	10:10654
EGG-RE-E-				
77-130-Suppl.2	*See* EGG/LTR-144-8-Suppl.2	DE85004837	MN -78	10:9875
EGG-SE-				
6746	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85005171	MN -96	10:10053
EPA-				
600/ 7-84-096	*See* TVA/OP/EDT-84/9	DE85900875	MN -90i	10:9503
EPA/450/3-				
81/ 003A	*See* PB-84-237320			10:10398
EPA/600-				
D-84/ 209	*See* PB-84-234657			10:10036
EPRI-AP-				
3753	Research Reports Center, Box 50490 Palo Alto, CA 94303, $8.50	TI85920085	ND -92	10:10233
EPRI-CS-				
3717	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $28.00	TI85920084	ND -93	10:9778
EPRI-EA-				
3698-CCM-Vol.2	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303	TI85920115	ND -97b	10:9981
EPRI-EL-				
3712	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303	TI85920151	ND -97	10:9779
3766-Vol.1	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $10.00	TI85920127	ND -97	10:9786
3766-Vol.2	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303	TI85920129	ND -97	10:9787
3771	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $17.50	TI85920125	ND -97a	10:9780
EPRI-NP-				
3719	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $13.00	TI85920146	ND -78	10:9792
3732	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $13.00	TI85920107	ND -78	10:9804
3734	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $22.00	TI85920142	ND -78	10:9805
3774-Vol.1	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $13.00	TI85920116	ND -80	10:9908

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3774-Vol.3	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $14.50	TI85920141	ND -80	10:9909
3779	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $14.50	TI85920108	ND -80	10:9871
3782	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $10.00	TI85920120	ND -78	10:9793
EUR-				
8635-EN-230	*See* PB-84-236256			10:9982
9196/ II-EN	Commission of the European Communities, Ispra (Italy). Biology Div.			10:9954
9209-EN	Commission of the European Communities, Luxembourg		ND -4	10:10151
FE-				
2013-16	*See* DOE/ET/10518-T8	DE85004107	MN -90d	10:9436
2893-143	*See* DOE/ET/10069-T99	DE85003901	MN -90d	10:9433
FEI-				
1491	NTIS (US Sales Only), PC A02/MF A01	DE84703429	MN -80	10:9863
1493	NTIS (US Sales Only), PC A02/MF A01	DE84703434	MN -80	10:9864
FLPU-				
83-6	NTIS (US Sales Only), PC A03/MF A01	DE84703461	MN -70	10:10386
83-7	NTIS (US Sales Only), PC A04/MF A01	DE84703462	MN -70	10:9608
FNAL-TM-				
1209	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004259	MN -48	10:10296
FR-				
188	*See* AD-A-144147/6			10:9989
FTD-ID(RS)T-				
0717-84	*See* N-84-33217			10:10073
GAO/RCED-				
84-166	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI85900447	MN -11	10:9960
GEAP-				
22076-Vol.1	NTIS (US Sales Only), PC A09/MF A01; 1 (GPO Dep.)	DE85004117	STD -78	10:9794
22076-Vol.2	NTIS (US Sales Only), PC A99/MF A01; 1 (GPO Dep.)	DE85004120	STD -78	10:9795
GEND-INF-				
047	YE07/, $5.50; 1 (GPO Dep.)	DE85004314	MN -78	10:9910
GLC-RDG-				
42	British Library Lending Division, Boston Spa, Wetherby LS23 7BQ		ND -70	10:9597
GNT-				
02/ 83	*See* CNEN-DR-118/83	DE84703445	MN -78	10:9896
GPO-				
35-356	*See* N-84-26476			10:9968
GRS-A-				
644	Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)			10:9853
706	Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)		ND -81	10:9911
761	Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)		ND -81	10:9912
807	Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)		ND -81	10:9913
816	Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)		ND -79p	10:9914
HEDL-SA-				
3125	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003018	MN -78	10:9868
3178-FP	NTIS, PC A02MF A01; 1 (GPO Dep.)	DE85002996	MN -79e	10:9915
3196-FP	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001068	MN -25	10:10066
3211-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85002008	MN -79e	10:9820
3213-FP	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85002999	MN -79e	10:9821
HMI-B-				
411	Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)		ND -25	10:10589
HSE-Trans-				
7256	NTIS (US Sales Only), PC A02/MF A01; 1	DE85900524	MN -88	10:9527
7261	NTIS (US Sales Only), PC A02/MF A01; 1	DE85900543	MN -88	10:9526
7262	NTIS (US Sales Only), PC A02; 3	DE85900540	MN -88	10:9522
7263	NTIS (US Sales Only), PC A02/MF A01; 1	DE85900541	MN -88	10:9525
8460	NTIS (US Sales Only), PC A02; 3	DE85900544	MN -88	10:9521
8469	NTIS (US Sales Only), PC A02; 3	DE85900536	MN -88	10:9520
8472	NTIS (US Sales Only), PC A02; 3	DE85900534	MN -88	10:9519
10009	NTIS (US Sales Only), PC A02/MF A01; 1	DE85900526	MN -88	10:9518
10013	NTIS (US Sales Only), PC A02/MF A01; 1	DE85900527	MN -88	10:9517
10014	NTIS (US Sales Only), PC A02; 3	DE85900532	MN -88	10:9516
IAE-				
3736/ 5	NTIS (US Sales Only), PC A02/MF A01	DE84703430	MN -80	10:9816
IAEA-TECDOC-				
303	NTIS (US Sales Only), PC A06/MF A01	DE84703436	MN -80	10:9916
ICTIS/M-				
0171	University of Bradford, Working Environment Research Group, England			10:9551
INP-				
1168-PH	NTIS (US Sales Only), PC A06/MF A01	DE84703426	MN -28	10:10270

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1169/ PL	NTIS (US Sales Only), PC A03/MF A01	DE84703453	MN -37	10:10299
INPE-				
3064-PRE/ 481	*See* N-84-26418			10:10597
3065-PRE/ 482	*See* N-84-26408			10:10596
3118-PRE/ 513	*See* N-84-26407			10:10595
INTRON-				
83228	INTRON B.V., Maastricht, Netherlands			10:9498
83234	INTRON B.V., Maastricht, Netherlands			10:9499
83248	INTRON B.V., Maastricht, Netherlands			10:9500
IPEN-Inf-				
13	NTIS (US Sales Only), PC A02/MF A01	DE84703431	MN -80	10:9796
IPEN-Pub-				
50	NTIS (US Sales Only), PC A02/MF A01	DE84703432	MN -80	10:9854
51	NTIS (US Sales Only), PC A02/MF A01	DE84703447	MN -78	10:9797
IPPJ-				
666	*See* N-84-25460			10:10498
667	*See* N-84-25461			10:10624
668	*See* N-84-25463			10:10657
669	*See* N-84-25462			10:10625
IPPJ-AM-				
34	*See* N-84-25459			10:10497
IS-M-				
506	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003216	MN -4	10:10152
522	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003069	MN -34	10:10605
524	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003079	MN -34C	10:10106
IS-T-				
1102	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE85005136	MN -34D	10:10517
1117	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85005117	MN -4	10:10160
1125	NTIS, PC A05/MF A01 (GPO Dep.)	DE85005119	MN -25	10:10067
1129	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE85004182	MN -4	10:10171
1130	NTIS, PC A06/MF A01 (GPO Dep.)	DE85005118	MN -34	10:10606
1137	NTIS, PC A07/MF A01 (GPO Dep.)	DE85005206	MN -38	10:10068
1153	NTIS, PC A10/MF A01 (GPO Dep.)	DE85005116	MN -4	10:10161
1156	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE85004485	MN -4	10:10153
1161	NTIS, PC A10/MF A01 (GPO Dep.)	DE85004174	MN -11	10:10379
IVL-B-				
731	NTIS (US Sales Only), PC A02/MF A01; 1	DE85750193	MN -11	10:10387
IWGFR-				
42	NTIS (US Sales Only), PC A08/MF A01	DE85780224	MN -79	10:9831
JEN-				
556	*See* N-84-26427			10:10116
JPL-				
9950-895	*See* N-84-29351			10:9680
9950-945	*See* DOE/CS/54209-20	DE85004579	STD -96	10:10054
JPL-PUB-				
83-100	*See* N-84-21609			10:9653
JSR-				
82-110	*See* AD-A-144447/0			10:10205
K/PS-				
915	NTIS, PC A04/MF A01 (GPO Dep.)	DE85004790	MN -4	10:10178
KAPL-				
4181	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003663	STD -37	10:10317
KEMA-				
8139-83-MO-L	Keuring van Elektrotechnische Materialen N.V., Arnhem, Netherlands			10:9506
KHM-TR-				
37	NTIS (US Sales Only), PC A06/MF A01; 1	DE85750165	MN -95e	10:9781
73	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750155	MN -90i	10:10388
KVL-JI-MEDD-				
43	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750133	MN -61	10:9652
LA-				
8050-NERP-Vol.2	NTIS, PC A04/MF A01 (GPO Dep.)	DE85004609	STD -11	10:10392
9771-MS	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85005189	STD -37	10:10318
10138-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005235	STD -28	10:10276
10153-MS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004627	STD -34	10:10303
10169-MS	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005187	STD -10	10:9592
10172-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005188	STD -45	10:10334
10173-MS	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005195	STD -45	10:10335
10189-PR	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85005194	STD -80	10:9855
10202-MS	NTIS, PC A03/MF A01 (GPO Dep.)	DE85005193	STD -34	10:10505
10208-M	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85005234	STD -32	10:10817
10209-MS	NTIS, PC A04/MF A01 (GPO Dep.)	DE85005228	STD -66a	10:9757
10214-T	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85005190	STD -41	10:10417
10234-MS	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85005231	STD -66a	10:9758
10246-MS	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005230	STD -41	10:10411
10258-M	NTIS, PC A03/MF A01 (GPO Dep.)	DE85004482	STD -34C	10:10590
10264-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005192	STD -37	10:10304
10274-MS	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005186	STD -37	10:10319
LA-UR-				
84-2651	NTIS, PC A03/MF A01 (GPO Dep.)	DE84016460	MN -80	10:9844
84-3470	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003746	MN -34C	10:10585
84-3537	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003748	MN -32	10:10815
84-3557	NTIS, PC A03/MF A01 (GPO Dep.)	DE85003728	MN -34C	10:10580
84-3576	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003742	MN -20g	10:10655

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84-3577	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003733	MN -37	10:10305
84-3583	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003741	MN -34B	10:10454
84-3627	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003739	MN -34	10:10277
84-3673	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003738	MN -91	10:9584
84-3688	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003736	MN -34B	10:10455
84-3755	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003735	MN -25	10:10179
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84-47	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004596	MN -35	10:10357
84-51	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004597	MN -11	10:10360
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17449	NTIS, PC A02; 3	DE85004654	MN -70	10:10434
17490	NTIS, PC A02; 3	DE85004660	MN -70	10:10435
17655	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005166	MN -28	10:10197
17747	NTIS, PC A02; 3	DE85005167	MN -25	10:10069
17904	NTIS, PC A02; 3	DE85004903	MN -25	10:10137
17914	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004909	MN -34	10:10593
18148	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE85004509	MN -48	10:10412
18179	NTIS, PC A07/MF A01 (GPO Dep.)	DE85004088	MN -25	10:10107
18303	NTIS, PC A11/MF A01 (GPO Dep.)	DE85004896	MN -48	10:10413
18311	NTIS, PC A15/MF A01; 1 (GPO Dep.)	DE85005162	MN -4	10:10070
18341	NTIS, PC A08; 3	DE85004659	MN -34D	10:10512
18403	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004662	MN -28	10:10250
18411	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE85005101	MN -25	10:10108
18412	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004894	MN -25	10:10138
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18504	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004661	MN -32	10:10828
18549	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005165	MN -25	10:10163
18594	NTIS, PC A06/MF A01 (GPO Dep.)	DE85004657	MN -34A	10:10495
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18649	NTIS, PC A16/MF A01 (GPO Dep.)	DE85003843	MN -4	10:10401
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18691	NTIS, PC A13/MF A01 (GPO Dep.)	DE85005155	MN -48	10:10402
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18730	NTIS, PC A08/MF A01 (GPO Dep.)	DE85005156	MN -4	10:10165
LiU-TemaV-RB-				
83-5	University of Linkoeping, Department of Water in Environment and Society, S-581 83 Linkoeping, Sweden	TI85750192	ND -11	10:9967
LP-				
203	*See* N-84-26410			10:10627
205	*See* N-84-26411			10:10628
LR-				
447(AP) -M	*See* PB-84-234046			10:10055
LUTMDN/TMVK-				
1005/ 1-225	Tekniska Hoegskolan, Institutionen foer Vaerme- och Kraftteknik, Lund, Sweden	TI85750188	ND -95d	10:10608
3117/ 1-32	NTIS (US Sales Only), PC A03/MF A01	DE85750161	MN -95d	10:10042
MITT-				
35	*See* N-84-21826			10:10221
MPE-				
181	*See* N-84-25557			10:10457
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84-20526	NTIS, PC A14/MF A01			10:9550
84-20527	NTIS, PC A14/MF A01			10:9579
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84-20561	NTIS, PC A14/MF A01			10:10239
84-20632	NTIS, PC A05/MF A01			10:10496
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84-20720	NTIS, PC A14/MF A01			10:10220
84-20727	NTIS, PC A14/MF A01			10:10009
84-20728	NTIS, PC A14/MF A01			10:10033

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84-21347	NTIS, PC A16/MF A01			10:10109
84-21348	NTIS, PC A16/MF A01			10:9991
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84-21351	NTIS, PC A16/MF A01			10:9993
84-21353	NTIS, PC A16/MF A01			10:10110
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84-21676	NTIS, PC A03/MF A01			10:10188
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84-21740	NTIS, PC A03/MF A01			10:10115
84-21751	NTIS, PC A04/MF A01			10:10141
84-21826	Ruhr-Univ., Bochum, Germany			10:10221
84-21830	NTIS, PC A06/MF A01			10:10240
84-21849	NTIS, PC A02/MF A01			10:10222
84-24655	NTIS, PC A09/MF A01			10:9654
84-24660	NTIS, PC A09/MF A01			10:10456
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84-25557	NTIS, PC A06/MF A01			10:10457
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84-25891	NTIS, PC A08/MF A01			10:10461
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84-26408	[illegible] MF A01			10:10596
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84-26501	NTIS, PC A09/MF A01			10:10464
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84-29332	NTIS, PC A12/MF A01			10:9702

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84-29345	NTIS, PC A12/MF A01			10:9678
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84-29348	NTIS, PC A16/MF A01			10:9679
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84-29374	NTIS, PC A02/MF A01			10:10490
84-30326	British Library Lending Div., Boston Spa, England			10:9798
84-30352	NTIS, PC A02/MF A01			10:9806
84-30435	NTIS, PC A04/MF A01			10:10361
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12553	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004472	MN -80	10:10074
12556	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004471	MN -80	10:10075
12577	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004470	MN -80	10:9846
NASA-CP-				
2314	*See* N-84-29307			10:9655
NASA-CR-				
166593	*See* N-84-32201			10:10072
171080	*See* N-84-29374			10:10490
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171133	*See* N-84-32168			10:10320
173465	*See* N-84-21609			10:9653
173592	*See* N-84-26535			10:10467
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173609	*See* N-84-26537			10:10469
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173889	*See* N-84-33310			10:10473
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173919	*See* N-84-33323			10:10479
174623	*See* N-84-20632			10:10496

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174661	*See* N-84-21677			10:10189
174813	*See* DOE/NBB-0067	DE85005223	STD -96	10:10056
NASA-TM-				
77435	*See* N-84-20697			10:10139
77453	*See* N-84-29356			10:9646
83593	*See* N-84-26484			10:10051
83630	*See* N-84-21849			10:10222
83680	*See* N-84-29347			10:9773
83739	*See* N-84-30528			10:9951
85071	*See* N-84-33333			10:10485
85964	*See* N-84-32131			10:10500
86100	*See* N-84-25565			10:10460
86117	*See* N-84-32338			10:10472
86121	*See* N-84-26409			10:10506
86126	*See* N-84-32337			10:10471
86131	*See* N-84-32333			10:10470
86132	*See* N-84-33332			10:10484
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86140	*See* N-84-33326			10:10481
86142	*See* N-84-33325			10:10480
86147	*See* N-84-33320			10:10477
NASA-TP-				
2286	*See* N-84-21740			10:10115
2331	*See* N-84-25458			10:10656
NBSIR-				
84-2917	NTIS, PC A03/MF A01 (GPO Dep.)	DE85004295	MN -38	10:10011
84-2972	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004698	MN -59b	10:9746
84-2980	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85005227	STD -59a	10:9747
NCEL-TR-				
910	*See* AD-A-145088/1			10:10027
NE-				
1983-11	NTIS (US Sales Only), PC A12/MF A01; 1	DE85750160	MN -61A	10:9683
NE-FBA-				
83-18	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750174	MN -38	10:10227
83-19	NTIS (US Sales Only), PC A05; 3	DE85750173	MN -61D	10:9684
NE-SBT-				
83-23	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750175	MN -61	10:9685
NF-				
2117	Nijverheidsorganisatie TNO, Inst. voor Milieuhygiene en Gezondheidstechniek, Delft, Netherlands			10:9501
NG-				
1251	Nijverheidsorganisatie TNO, Inst. voor Milieuhygiene en Gezondheidstechniek, Delft, Netherlands			10:9507
NIIAR-				
13(578)	NTIS (US Sales Only), PC A02/MF A01	DE84703451	MN -37	10:9883
20(585)	NTIS (US Sales Only), PC A03/MF A01	DE84703433	MN -80	10:9856
27(592)	NTIS (US Sales Only), PC A02/MF A01	DE84703437	MN -78	10:9799
33(598)	NTIS (US Sales Only), PC A02/MF A01	DE84703438	MN -78	10:9800
NIKHEF-H-				
84-1-SING-2	NTIS (US Sales Only), PC A03/MF A01	DE84703452	MN -37	10:10306
NIPER-				
23-Vol.2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004851	MN -92	10:9573
NP-				
5750114	Jydsk Teknologisk Institut, Aarhus, Denmark	TI85750114	ND -96	10:10028
5750117	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750117	MN -92b	10:10034
5750138	Teknologisk Instituts Forlag, Taastrup, Denmark	TI85750138	ND -95d	10:10012
5750140	NTIS (US Sales Only), PC A03; 3	DE85750140	MN -97e	10:9650
5750142	Jydsk Teknologisk Institut, Aarhus, Denmark	TI85750142	MN -96	10:9649
5750144	NTIS (US Sales Only), PC A09/MF A01; 1	DE85750144	MN -38	10:10241
5750149	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750149	MN -95d	10:10013
5750152	NTIS (US Sales Only), PC A02/MF A01; 1	DE85750152	MN -95f	10:10035
5750176	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750176	MN -95	10:10014
5770001	NTIS (US Sales Only), PC A03/MF A01; 1	DE85770001	MN -97e	10:10438
5900345	American Petroleum Inst., Washington, DC	TI85900345	MN -92	10:9575
5900350	NTIS, PC A06/MF A01; 1	DE85900350	MN -98A	10:9552
5900439	NTIS, PC A04/MF A01	TI85900439	MN -48	10:10409
5900700	School of Mines and Energy Development (SOMED), Box 6282, University of Alabama, University (Tuscaloosa), AL 35486	TI85900700	MN -92a	10:9557
NPS-				
61-84-004	*See* AD-A-144538/6			10:10647
NR-				
83/ 137a	Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Delft, Netherlands			10:9553
83/ 175	Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Delft, Netherlands			10:9484
84/ 47	Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Delft, Netherlands			10:9485
84/ 157	Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Delft, Netherlands			10:9554
NRL-MR-				
5406	*See* AD-A-145155/8			10:10618

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NU-				
1983-3	Nordisk Ministerraad	TI85750189	ND -98A	10:9539
NUREG-				
0020-Vol.8-No.10	NTIS, PC A18/MF A01 - GPO*	TI85900701	MN -78	10:9788
0540-Vol.6-No.9	NTIS, PC A22/MF A01 - GPO	TI85900712	MN -2	10:9847
0606-Vol.6-No.4	NTIS, PC A05/MF A01 - GPO*	TI85900852	MN -80	10:9917
0750-Vol.20-No.3	NTIS, PC A12/MF A01 - GPO*	TI85900677	MN -80	10:9848
0787-Suppl.8	NTIS, PC A05/MF A01 - GPO* $4.75	TI85900859	MN -78	10:9918
0837-Vol.4-No.2	NTIS, PC A07/MF A01 - GPO*	TI85900737	MN -78	10:9873
0954-Suppl.4	NTIS, PC A10/MF A01 - GPO $6.50	TI85900738	MN -78	10:9919
0973	NTIS, PC A22/MF A01 - GPO* $10.00	TI85900645	MN -78	10:9807
1012	NTIS, PC A21/MF A01 - GPO* $10.00	TI85900854	MN -78	10:9801
1061-Vol.3	NTIS, PC A10/MF A01 - GPO* $6.00	TI85900518	MN -78	10:9920
1099	NTIS, PC A22/MF A01 - GPO* $10.00	TI85900853	MN -78	10:9808
NUREG/CR-				
0169-Vol.22	NTIS, PC A03/MF A01 - GPO	TI85005151	MN -78	10:9878
1408	NTIS, PC A04/MF A01 - GPO	TI85004740	MN -78	10:10076
1903	NTIS, PC A02/MF A01 - GPO	TI85004739	MN -78	10:9809
2331-Vol.4-No.1	NTIS, PC A08/MF A01 - GPO	TI85003898	MN -80	10:9921
2482-Vol.5	NTIS, PC A06/MF A01 - GPO $5.00	TI84017211	MN -70	10:10077
3019	NTIS, PC A02/MF A01 - GPO	TI84017027	MN -71	10:10198
3025	NTIS, PC A10/MF A01 - GPO	TI85003999	MN -78	10:9922
3195	NTIS, PC A03/MF A01 - GPO	TI83011206	MN -78	10:9923
3519	NTIS, PC A06/MF A01 - GPO	TI85003961	MN -80	10:9924
3521	NTIS, PC A04/MF A01 - GPO	TI85004312	MN -80	10:9925
3885-Vol.2	NTIS, PC A02/MF A01 - GPO	TI85003266	MN -77	10:9926
3898	NTIS, PC A05/MF A01 - GPO $4.75	TI85005001	MN -70	10:10123
3923	NTIS, PC A11 - GPO	TI85003976	MN -38	10:9952
3941-Vol.1	NTIS, PC A08/MF A01 - GPO* $5.50	TI85901071	MN -70	10:9628
3986	NTIS, PC A99/MF A01 - GPO	TI85003989	MN -78	10:9927
3994	NTIS, PC A07/MF A01 - GPO	TI85001619	MN -70B	10:9632
3995	NTIS, PC A10/MF A01 - GPO* $6.50	TI85900861	MN -80	10:9928
4002	NTIS, PC A09/MF A01 - GPO $6.00	TI85003891	MN -11	10:9956
4017	NTIS, PC A03/MF A01 - GPO	TI85005153	MN -80	10:9872
4019	NTIS, PC A08/MF A01 - GPO* $6.00	TI85900860	MN -80	10:9789
4021	NTIS, PC A06/MF A01 - GPO	TI85004313	MN -80	10:9929
4031-Vol.1	NTIS, PC A04/MF A01 - GPO	TI85004418	MN -80	10:9879
4032	NTIS, PC A02/MF A01 - GPO	TI85003960	MN -78	10:9810
4070-Vol.1	NTIS, PC A07/MF A01 - GPO $5.50	TI85004032	MN -80	10:9811
OA-tr-				
1868	NTIS (US Sales Only), PC A02; 3	DE85900546	MN -95d	10:10026
ONRL-R-				
8-84	*See* AD-A-144305/0			10:10429
ORAU-				
238	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004491	MN -13	10:9969
ORNL-				
6064	NTIS, PC A19/MF A01; 1 (GPO Dep.)	DE85004954	MN -11	10:10367
6072	NTIS, PC A03/MF A01 (GPO Dep.)	DE85004787	STD -95	10:10117
6077	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004812	STD -41	10:10414
6108	NTIS, PC A07/MF A01 (GPO Dep.)	DE85004939	STD -90d	10:9430
ORNL/FMP-				
84/ 4	NTIS, PC A16/MF A01; 1 (GPO Dep.)	DE85004771	MN -90	10:9464
ORNL/NUREG/TM-				
430	*See* NUREG/CR-1903	TI85004739	MN -78	10:9809
ORNL/TM-				
8591	NTIS, PC A05/MF A01 (GPO Dep.)	DE85004947	MN -11	10:9508
8668	NTIS, PC A05/MF A01 (GPO Dep.)	DE85004948	STD -86	10:9593
8864	NTIS, PC A05/MF A01 (GPO Dep.)	DE85004945	MN -11	10:10385
8910	NTIS, PC A04/MF A01 (GPO Dep.)	DE85004776	MN -11	10:10394
9090	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004938	STD -20f	10:10629
9161	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003798	STD -77	10:9817
9180	NTIS, PC A04/MF A01 (GPO Dep.)	DE85004950	MN -4	10:10166
9243	NTIS, PC A03/MF A01 (GPO Dep.)	DE85004943	MN -13	10:10368
9267/ V2	*See* NUREG/CR-3885-Vol.2	TI85003266	MN -77	10:9926
9296	NTIS, PC A09/MF A01 (GPO Dep.)	DE85005427	STD -20	10:10630
9301/ P1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004769	MN -90h	10:10078
9354	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004949	MN -70	10:10439
9361	NTIS, PC A05/MF A01 (GPO Dep.)	DE85004768	MN -70	10:10443
9367	NTIS, PC A04/MF A01 (GPO Dep.)	DE85004392	MN -80	10:9930
9388	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004786	STD -70	10:9598
9423/ V1	*See* NUREG/CR-4031-Vol.1	TI85004418	MN -80	10:9879
9430	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004764	MN -22	10:9641
9466	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004944	MN -25	10:10118
ORNL-tr-				
5166	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003529	MN -4	10:10121
ORO-				
4014-14	*See* DOE/ER/04014-14	DE85004464	MN -80	10:9874
5126-183	*See* DOE/ER/05126-183	DE85003016	MN -34D	10:10584
OTA-E-				
243	GPO*	TI85900702	MN -98B	10:9975
244	Congressional and Public Affairs Office, OTA-US Congress, Washington, DC 20510	TI85900703	MN -98B	10:9972
PB-				
84-181106	*See* N-84-30552			10:9681

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
84-201508	*See* N-84-33329			10:10482
84-201516	*See* N-84-33330			10:10483
84-230119	NTIS, PC A03/MF A01			10:10029
84-230143	NTIS, PC A03/MF A01			10:10030
84-230168	NTIS, PC A04/MF A01			10:10031
84-231398	NTIS PC E06/MF E06			10:10504
84-231554	NTIS PC E04/MF E04			10:10211
84-232537	NTIS, PC A04/MF A01			10:10369
84-234046	NTIS PC E10/MF E10			10:10055
84-234186	NTIS PC E04/MF E04			10:9782
84-234582	NTIS, PC A05/MF A01			10:10032
84-234657	NTIS, PC A06/MF A01			10:10036
84-235258	NTIS, PC A03/MF A01			10:9976
84-235266	NTIS, PC A03/MF A01			10:9977
84-235274	NTIS, PC A03/MF A01			10:9978
84-236256	NTIS PC E04/MF E04			10:9982
84-236850	NTIS, PC A06/MF A01			10:10370
84-237320	NTIS, PC A12/MF A01			10:10398
84-238815	NTIS, PC A08/MF A01			10:9714
84-238823	NTIS, PC A07/MF A01			10:9715
84-238831	NTIS, PC A08/MF A01			10:9716
84-238849	NTIS, PC A07/MF A01			10:9717
84-238856	NTIS, PC A12/MF A01			10:9718
84-238864	NTIS, PC A13/MF A01			10:9719
84-238872	NTIS, PC A16/MF A01			10:9720
84-238880	NTIS, PC A11/MF A01			10:9721
84-238898	NTIS, PC A15/MF A01			10:9722
84-238906	NTIS, PC A10/MF A01			10:9723
84-238914	NTIS, PC A18/MF A01			10:9724
84-238922	NTIS, PC A21/MF A01			10:9725
84-238930	NTIS, PC A21/MF A01			10:9726
84-238948	NTIS, PC A12/MF A01			10:9727
84-238963	NTIS, PC A11/MF A01			10:9728
84-238971	NTIS, PC A11/MF A01			10:9729
84-238989	NTIS, PC A16/MF A01			10:9730
84-239003	NTIS, PC A13/MF A01			10:9731
84-239011	NTIS, PC A14/MF A01			10:9732
84-239029	NTIS, PC A13/MF A01			10:9733
84-239037	NTIS, PC A21/MF A01			10:9734
84-239045	NTIS, PC A03/MF A01			10:9735
84-242122	NTIS, PC A04/MF A01			10:10420
84-243443	NTIS PC E03/MF E01			10:10397
PFC/RR-				
83-26	*See* DOE/ET/51013-97	DE85004846	MN -20f	10:10623
83-27	*See* DOE/ET/51013-98	DE85004919	MN -20	10:10650
84-11	*See* DOE/ET/51013-127	DE85004959	MN -20a	10:10651
84-12	*See* DOE/ET/51013-129	DE85004960	MN -20a	10:10652
84-13	*See* DOE/ET/51013-130	DE85004961	MN -20	10:10653
PML-				
1983-34	*See* N-84-21676			10:10188
1984-IN-008	Nijverheidsorganisatie TNO, Prins Maurits Laboratorium, Rijswijk, Netherlands			10:9509
PNCT-J-				
965-82-01	NTIS (US Sales Only), PC A03/MF A01	DE84703450	MN -79	10:9931
PNL-				
4955-2	NTIS, PC A03/MF A01 (GPO Dep.)	DE85005098	MN -70	10:9609
5118-3	NTIS, PC A03/MF A01 (GPO Dep.)	DE85005411	MN -90c	10:9465
5152-Pt.1	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE85005096	MN -11	10:10371
5152-Pt.3	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE85004907	MN -11	10:10372
5226	*See* NUREG/CR-4002	TI85003891	MN -11	10:9956
5300-Vol.1	*See* NUREG/CR-4070-Vol.1	TI85004032	MN -80	10:9811
5345	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004102	MN -41	10:10380
PNL-SA-				
9582	NTIS, PC A03/MF A01	TI85004755	MN -78	10:9869
11294	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005529	MN -37	10:10323
12173	NTIS, PC A03/MF A01 (GPO Dep.)	DE85003645	MN -51	10:9629
12237	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003110	MN -78	10:9932
12263	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004549	MN -37	10:10307
12321	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004578	MN -70	10:9610
12322	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004544	MN -70	10:9611
12325	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004529	MN -70	10:9612
12344	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004548	MN -70	10:10079
12427	NTIS, PC A02/F A01 (GPO Dep.)	DE85003637	MN -90a	10:10421
12611	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003017	MN -37	10:10308
12616	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004554	MN -15	10:9634
12667	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003599	MN -78	10:9933
12746	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004551	MN -70	10:9513
PPPL-				
2159	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85005095	STD -20b	10:10658
2163	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85003885	STD -20f	10:10631
RADC-TR-				
84-5	*See* AD-A-144713/5			10:10312
RAL-				
84-045	*See* PB-84-234186			10:9782

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RFP-				
3555	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004097	MN -70	10:9614
3562	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85003908	MN -60	10:9768
3565	NTIS, PC A02; 3	DE85003984	MN -86	10:9594
3573	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85003964	MN -4	10:10143
3597	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003895	MN -46	10:10199
3602	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003971	MN -41	10:10415
3627	NTIS, PC A02; 3	DE85003911	MN -4	10:10155
3644	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004979	MN -37	10:10212
3645	NTIS, PC A02; 3	DE85003958	MN -70	10:9635
3660	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005169	MN -70	10:9615
3670	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004983	MN -46	10:10200
3696	NTIS MF A01; 2 (GPO Dep.)	DE85004966	MN -15	10:9636
3705	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004972	MN -10	10:10167
3712	NTIS, PC A02; 3	DE85004974	MN -47	10:10080
3714	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005185	MN -4	10:10168
3717	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005184	MN -38	10:10201
3719	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005183	MN -10	10:9595
3723	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005182	MN -37	10:10309
3741	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005180	MN -70B	10:9616
3743	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005179	MN -41	10:10433
3748	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005178	MN -25	10:10081
RHO-HS-ST-				
5P	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004010	MN -41	10:10592
RHO-RE-ST-				
29-P	NTIS, PC A03/MF A01 (GPO Dep.)	DE85005148	MN -70	10:9617
RHO-ST-				
46P	NTIS, PC A20/MF A01; 1 (GPO Dep.)	DE85004461	MN -11	10:10391
RISO-M-				
2388	NTIS (US Sales Only), PC A07/MF A01; 1	DE85750128	MN -92a	10:9558
2420	NTIS (US Sales Only), PC A06/MF A01	DE85750119	MN -11	10:9510
2421	NTIS (US Sales Only), PC A07/MF A01	DE85750118	MN -92	10:9561
RP-				
5/ 82	*See* N-84-20716			10:10140
SAEK-				
1-S(82) 1	*See* STUDSVIK-NR-82/95	DE84703465	MN -2	10:9802
SAND-				
80-2050	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004807	STD -37	10:10324
82-0572	NTIS, PC A03/MF A01 (GPO Dep.)	DE85004148	MN -32	10:10616
82-2477	*See* NUREG/CR-3025	TI85003999	MN -78	10:9922
83-1715	*See* NUREG/CR-3521	TI85004312	MN -80	10:9925
83-2155	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004096	STD -23	10:9642
84-0237	NTIS, PC A04/MF A01 (GPO Dep.)	DE85004855	STD -62	10:9748
84-0478C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004466	MN -25	10:10144
84-0857	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE85005199	STD -66c	10:9765
84-1060	NTIS, PC A03/MF A01 (GPO Dep.)	DE85004656	STD -70	10:10444
84-1062	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004628	MN -60	10:9774
84-1219	*See* NUREG/CR-3986	TI85003989	MN -78	10:9927
84-1227C	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003450	MN -60	10:9767
84-1254C	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003988	MN -25	10:10145
84-1287C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85002631	MN -60	10:9775
84-1346	NTIS, PC A03/MF A01 (GPO Dep.)	DE85005197	MN -2	10:10358
84-1373C	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003250	MN -34	10:10598
84-1450C	NTIS, PC A02; 3	DE85003119	MN -80	10:9934
84-1464C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000470	MN -25	10:10599
84-1655C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85002623	MN -78	10:9935
84-1737	*See* NUREG/CR-3923	TI85003976	MN -38	10:9952
84-1759C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85002642	MN -78	10:10124
84-1824C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003338	MN -80	10:9936
84-1851C	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003694	MN -41	10:9937
84-1887C	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017058	MN -80	10:9938
84-2192C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004908	MN -11	10:10441
84-2384C	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004292	MN -38	10:10192
84-2574C	NTIS, PC A02; 3	DE85003949	MN -4	10:10146
SBI-MEDD-				
10	NTIS (US Sales Only), PC A06/MF A01; 1	DE85750122	MN -95d	10:10015
33	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750120	MN -95	10:10016
SBI-R-				
148	NTIS (US Sales Only), PC A05/MF A01	DE85750134	MN -95d	10:10017
152	NTIS (US Sales Only), PC A03/MF A01	DE85750121	MN -95	10:10018
153	NTIS (US Sales Only), PC A03/MF A01	DE85750143	MN -95d	10:10019
155	NTIS (US Sales Only), PC A04/MF A01	DE85750146	MN -95	10:10020
159	NTIS (US Sales Only), PC A04/MF A01	DE85750151	MN -95d	10:10021
SERI/STR-				
211-2363	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE84013002	STD -63	10:9691
211-2409	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85000525	MN -63	10:9692
211-2471	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85000524	MN -63	10:9693
214-2554	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE85002910	MN -60	10:9769
SERI/TP-				
214-2563	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000530	MN -60	10:9776
SGD-				
475-PT-1	*See* N-84-33329			10:10482
475-PT-2	*See* N-84-33330			10:10483

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SI-				
1-1984	Skovteknisk Institut, Copenhagen, Denmark	TI85750136	ND -61A	10:9694
SKBF-KBS-TR-				
83-23	NTIS (US Sales Only), PC A04/MF A01	DE84703457	MN -70	10:9618
83-42	NTIS (US Sales Only), PC A04/MF A01	DE84703463	MN -70	10:9619
SLAC-CN-				
279	*See* SLAC-PUB-3453	DE85004890	MN -28	10:10257
SLAC-PUB-				
3433	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004381	MN -28	10:10251
3453	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004890	MN -28	10:10257
SLU-IVL-				
143	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750182	MN -61	10:9695
144	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750183	MN -61D	10:9696
146	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750184	MN -61	10:9697
148	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750185	MN -61	10:9983
150	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750186	MN -61	10:9698
152	Sveriges Lantbruksuniversitet, Institutionen foer Virkeslaera, Uppsala	TI85750187	ND -61	10:9699
SMRE-Trans-				
7257	NTIS (US Sales Only), PC A02; 3	DE85900548	MN -88	10:9523
7259	NTIS (US Sales Only), PC A02; 3	DE85900545	MN -88	10:9524
SNV-PM-				
1636	NTIS (US Sales Only), PC A14/MF A01; 1	DE85750164	MN -11	10:10373
1637	NTIS (US Sales Only), PC A09/MF A01; 1	DE85750163	MN -11	10:10374
1672	Statens Naturvaardsverk, Stockholm, Sweden		ND -11	10:10395
1742	NTIS (US Sales Only), PC A06/MF A01; 1	DE85750169	MN -41	10:10375
1763	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750170	MN -11	10:10376
SP-RAPP-				
1983-41	NTIS (US Sales Only), PC A07/MF A01; 1	DE85750179	MN -59a	10:9753
SRDP-PR-				
2	NTIS (US Sales Only), PC A03/MF A01	DE84703466	MN -16	10:9637
3	NTIS (US Sales Only), PC A03/MF A01	DE84703467	MN -16	10:9638
SRDP-R-				
100	NTIS (US Sales Only), PC A04/MF A01	DE84703468	MN -16	10:9639
103	NTIS (US Sales Only), PC A02/MF A01	DE84703469	MN -16	10:9640
104	NTIS (US Sales Only), PC A02/MF A01	DE84703470	MN -16	10:9880
SS-				
689-R	*See* AD-288073/0			10:9998
STUB-				
12	STUB Samarbejdsgruppen for Teknologisk Udvikling af Biogas, Glostrup, Denmark	TI85750127	ND -61E	10:10422
STUDSVIK-				
83-2	NTIS (US Sales Only), PC A03/MF A01	DE85750171	MN -95d	10:9948
STUDSVIK-NR-				
82/ 95	NTIS (US Sales Only), PC A04/MF A01	DE84703465	MN -2	10:9802
SVC-				
83-37	Svejsecentralen, Glostrup, Denmark	TI85750115	ND -41	10:10423
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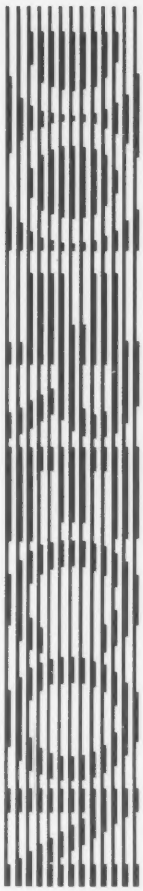

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